FINAL REPORT

Quantifying *In Situ* Contaminant Mobility in Marine Sediments

ESTCP Project ER-9712

JANUARY 2008

Mr. Bradley Davidson
Tom Hampton
Bart Chadwick
SPAWAR Systems Center

Environmental Security Technology Certification Program

Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE **JAN 2008**	2. REPORT TYPE	3. DATES COVERED **00-00-2008 to 00-00-2008**
4. TITLE AND SUBTITLE **Quantifying In Situ Contaminant Mobility in Marine Sediments**		5a. CONTRACT NUMBER 5b. GRANT NUMBER 5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)		5d. PROJECT NUMBER 5e. TASK NUMBER 5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **Space and Naval Warfare Systems Center Pacific ,53560 Hull Street,San Diego,CA,92152-5001**		8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)		10. SPONSOR/MONITOR'S ACRONYM(S) 11. SPONSOR/MONITOR'S REPORT NUMBER(S)
12. DISTRIBUTION/AVAILABILITY STATEMENT **Approved for public release; distribution unlimited**		
13. SUPPLEMENTARY NOTES		
14. ABSTRACT		
15. SUBJECT TERMS		

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT **unclassified**	b. ABSTRACT **unclassified**	c. THIS PAGE **unclassified**	**Same as Report (SAR)**	**385**	

Standard Form 298 (Rev. 8-98)
Prescribed by ANSI Std Z39-18

Table of Contents

List of Figures

List of Tables

Quantifying *In Situ* Metal and Organic Contaminant Mobility in Marine Sediments

Space and Naval Warfare Systems Center San Diego, CA

January 1, 2008

1. Introduction

1.1 Background Information

Contaminants enter shallow coastal waters from many sources, including ships, shoreside facilities, municipal outfalls, spills, and non point-source runoff. Sediments are typically considered a primary sink for these contaminants. Sediments in many bays, harbors and coastal waters used by DoD are contaminated with potentially harmful metal and organic compounds. The DoD is required by the Comprehensive Environmental Resource Conservation and Liability Act, as amended by the Superfund Amendment and Reauthorization Act of 1986 (CERCLA/SARA), to assess and if necessary remove and remediate these sites and discharges in order to protect the public health or welfare of the environment. To determine whether contaminants are moving into, out of, or remaining immobilized within the sediments, a determination of contaminant flux must be made. Variations in sediment chemical and physical properties make it impossible to rely on bulk sediment contaminant concentrations alone to predict contaminant flux, bioavailability, and therefore toxicity. Diagenetic reactions in surface sediments control contaminant pore water gradients, and the direction and magnitude of these gradients control the diffusive flux across the sediment-water interface. These fluxes can be calculated from measurements of contaminant pore water gradients and sediment physical properties. However, in some coastal areas pore water gradients are very steep and therefore difficult to measure. In addition, flux calculations based on pore water gradients only provide the diffusive component of a contaminant flux. An additional concern in coastal areas is that biological irrigation by infauna and wave or current induced flushing may provide a larger component of flux through advection of water through the sediments. To avoid these problems, a direct measurement of contaminant flux in coastal areas is often the best method to assess contaminant mobility across the sediment-water interface. This direct measurement can be made with a flux chamber that isolates a volume of seawater over the sediments to quantify contaminant flux across the sediment-water interface.

An instrument for measurement of contaminant fluxes from marine sediments called the Benthic Flux Sampling Device 2(BFSD2). The instrument is a commercialized version of the original prototype BFSD used during development and is adapted from benthic flux chamber technology developed in oceanography for studying the cycles of major elements and nutrients on the seafloor.

The BFSD2 is an autonomous instrument for *in-situ* measurement of toxicant flux rates from sediments. A flux out of or into the sediment is measured by isolating a volume of water above the sediment, drawing off samples from this volume over time, and analyzing these samples for increase or decrease in toxicant concentration. Increasing concentrations indicate that the toxicant is fluxing out of the sediment. Decreasing concentrations indicate that the toxicant is fluxing into the sediment.

Figure 1 shows the BFSD2, including its pyramid-shaped tubular frame, open-bottomed chamber, and associated sampling and control equipment. At the top of the frame is an acoustically released buoy for BFSD2 recovery. At the bottom of the frame is an open-bottomed chamber and associated sampling gear, flow-through sensors, a data acquisition and control unit, video camera system, power supply, and oxygen supply system.

Figure 1. Benthic Flux Sampling Device 2.

The BFSD2 provides a unique means of evaluating the significance of in-place sediment contamination. Knowledge of the degree to which contaminants remobilize is essential in defining the most cost effective remedial action at impacted sites. At present, there is no other viable method for direct quantification of sediments as sources. At sites where it can be demonstrated that remobilization of contaminants is limited, significant cost savings may be achieved through reduction of cleanup costs. This may often be the case because many contaminants are strongly sequestered within the sediment and not likely to leach out. Estimated disposal costs for contaminated sediments

range from \$100-\$1000/cubic yard. A recent survey of Navy shoreside facilities (NRaD, 1995) indicated that of the 31 facilities that responded, 29 reported the presence of contaminated sediment sites. The actual volume of contaminated sediment at these sites is not well-documented however even conservative estimates suggest that millions of cubic yards of material may exceed typical sediment quality guidelines.

1.2 Official DoD Requirement

This project addresses the DoD/Navy requirement for compliance, cleanup assessment, and remediation decisions using innovative technology to directly quantify the mobility and bioavailability of contaminants in marine sediments. Marine sediments serve as a repository for contamination from a wide variety of sources. The environmental risks posed by these contaminants are determined largely by the degree to which they remobilize into the environment.

1.2.1 How Requirements were Addressed

The technology demonstrated in this project provides a means of quantifying risks and supports the overall goal of cost-effective, risk-based environmental cleanup. This technology provides a basis for risk-based decision making and potential cost savings by

1. Improving methods for measuring bioavailability for contaminated sediment
2. Minimizing cleanup requirements at sites where contaminants are not remobilizing
3. Evaluating the integrity of natural and remedial sediment caps
4. Providing a direct measure of the time scale of natural attenuation
5. Documenting the actual contaminant contribution of sediments relative to other sources.

1.3 Objectives of the Demonstrations

The primary objective of the demonstrations of the BFSD2 was to perform deployments at contaminated sites in San Diego Bay, California and Pearl Harbor, Hawaii under the observation of California EPA certification evaluators. Other observers, including local, state and federal regulators, Remediation Program Managers, academic, industry and other DoD also attended. Each site offered different validation opportunities: San Diego Bay was used to show instrument repeatability and comparison with historical trends and Pearl Harbor was used to show site differences and geochemical trend analysis. Organics demonstrations were performed at the same sites. The specific planned objectives of the demonstrations were to:

(1) evaluate the quality of water samples collected using the BFSD2; specifically for use in determining if a statistically significant flux was occurring at the test locations in comparison to the blank flux results for the BFSD2.

(2) evaluate the BFSD2 for repeatability.

(3) evaluate the logistical and economic resources necessary to operate the BFSD2.

(4) evaluate the range of conditions in which the BFSD2 can be operated.

Other objectives included exposure of various user communities to the technology to encourage continued interest and applications.

1.4 Regulatory Issues

There were no regulatory permitting issues associated with deployment of the BFSD2. Collecting sediment samples in a marine environment is considered a nonhazardous activity (although personnel handling samples must follow all safety precautions and limit their exposure to potentially hazardous samples). No hazardous waste was generated during the demonstrations.

The BFSD2 is a sample collection instrument and its prototype was the first of its kind to collect sediment-water interface samples for contaminant flux analysis. Because this technology has no current equivalent, the BFSD2 is evaluated based on the internal quality assurance/quality control (QA/QC) for the laboratory analysis performed and on an analysis and interpretation of the data. Although some clean water standards have been set for seawater, only guidelines currently exist for sediments. And, whereas sample handling, preserving, analyzing and reporting is covered by a number of established methods and regulations, the primary regulatory issue for the BFSD2 involves the integrity of the collected samples to represent ambient conditions. Further, the heterogeneous nature of sediments combined with the complex chemistry of marine aquatic environments requires thoughtful evaluation of all data before arriving at conclusions. The BFSD2 system can routinely produce accurate, precise and repeatable results, however the application of these results to site specific conditions does not lend itself readily to standardized processes. In many cases, BFSD2 results may be used as an additional factor in a “weight of evidence” approach for risk-based decisions involving regulator concurrence.

1.5 Previous Testing of the Technology

Initial development program tests included *ex situ* (laboratory) and *in situ* (field) trials of critical components, subsystems, and systems. A number of system development tests were conducted at various locations within San Diego Bay during 1989-91.

Full-scale system trials of the prototype BFSD were conducted in Sinclair Inlet, offshore from Puget Sound Naval Shipyard, Bremerton WA, during June 1991 in support of an ongoing assessment. Ten deployments of the prototype BFSD were conducted to characterize flux rates of contaminants from seven shipyard sites and three reference sites (no blank test was conducted). Collected samples were analyzed for the trace metals arsenic (As), cadmium (Cd), chromium (Cr), copper (Cu), mercury (Hg), nickel (Ni), lead (Pb) and zinc (Zn). The tests were successful and results generally showed low release rates (or fluxes) compared to other contaminant sources. See general reference 12 for the complete report. Following review of the data, an active oxygen control subsystem with sensor feedback was developed and implemented along with several other changes to improve operation reliability.

During 1993 four systems tests of the upgraded prototype BFSD were conducted at sites within in San Diego Bay: one at Paleta Creek (at its entrance to the bay within Naval Station San Diego); two at a commercial yacht harbor (Shelter Island); and one at a industrial shipping terminal (PACO Industries). The deployments were preceded by a system blank test to determine the lower limits of flux that could be resolved with the prototype BFSD. Several experimental subsystems including a sensor for laser-induced fluorescence (LIF) investigation of polycyclic aromatic hydrocarbon (PAH) contaminants and an electrode for potentiometric stripping analysis (PSA) of trace metal (Cu and Zn) contaminants were also tested. Results from these deployments showed significant flux rates when compared to blank test results and clear differences between the sites as related to potential trace

metal sources. Paleta Creek results showed the highest flux levels for Cd, Cu, Ni and Zn. See reference 5 for the complete report.

Seven more prototype BFSD deployments in San Diego Bay in support of a sediment quality assessment at Naval Station San Diego were conducted during 1995. Paleta Creek was again included along with five other sites near piers and quay walls and one site outside the study area used as a reference. The work, preceded by a blank test, yielded results that were consistent with the previous study and showed Cd, Ni, Zn and Mn all to have positive fluxes. Paleta Creek again showed the highest trace metal fluxes with levels which were generally consistent with those measured two years prior. Correlations between measured trace metal flux levels and complex marine chemistry processes were studied and informative trends were identified. For example in the complex oxidation-reduction (redox) marine environment, it was found that trace metal fluxes are consistent with oxidation of solid metal sulfides as a sediment source. See key reference 7 for the complete report; an extract is included below to illustrate an initial interpretation of the Naval Station San Diego results:

> Some of these trace metal flux relationships may be better illustrated with bar charts showing the trends along a series of transects across the study area. Figures2 and 3 show the trace metal fluxes for the 1995 deployments along with data from the earlier 1993 deployments. The Zn fluxes in Figure 2 are so large that the other trace metal fluxes are barely visible, so the other metal fluxes are replotted in Figure 3 without Zn. This demonstrates that Zn is, by far, the trace metal with the largest flux out of the sediments. The first site displayed in both figures is the blank run, followed by the east-west transects near Pier 4 (Sites 3, 3r, 1r, and 2) and Paleta Creek (Sites 5, 4, and 6), and finally the 1993 data. Zn, Ni, and Cd fluxes in the 1995 data are high in the east (Sites 3 and 5) and decrease toward the west, and in the 1993 data higher in the central bay sites compared to north bay sites. The trends for Cu and Pb fluxes are less clear, with some sites showing fluxes into the sediments. Cu does, however, show the highest fluxes out of the sediments at Sites 3 and 5 where the sediment concentrations of most metals are high.

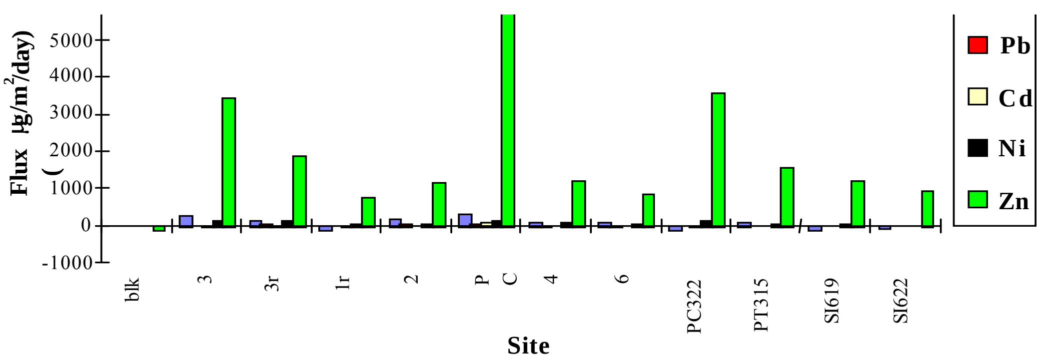


Figure 2. Plot of Metal Fluxes Along East-west Transects.

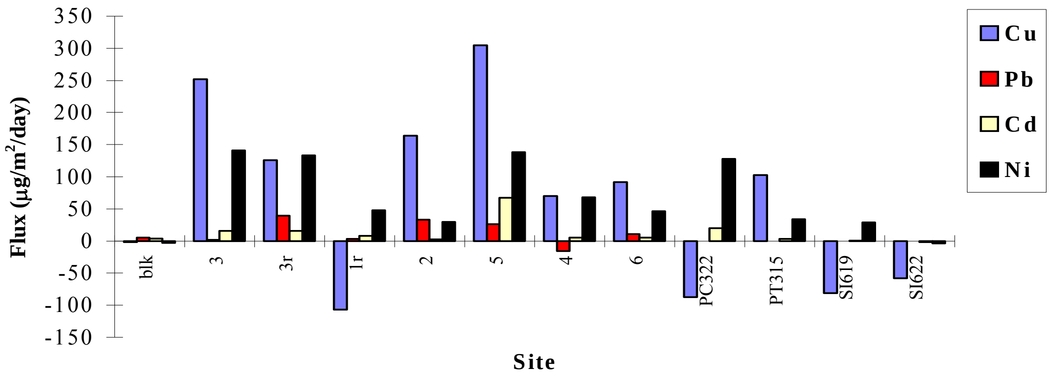


Figure 3. Plot of Metal Fluxes Along East-west Transects, Excluding Zn.

> Looking at the NAVSTA area sediments out to the west side of the navigation channel, a surface area of approximately 3 million square meters (m2) is present. From the contour map of Zn concentrations in the sediment chemistry chapter, only approximately 500,000 m2 are above the ERM value of 410 ppm. The four Zn flux measurements from sediments with these high Zn levels (Sites 1R, 3, 3R, and 5) average 3100 + 2500 ug/ m2 / day. Sediments in the NAVSTA area with Zn levels below ERM values cover approximately 2.5 million m2 and three flux measurements from sediments with lower Zn levels average 1100 + 200 ug/ m2 / day. The overall flux of zinc directly from the sediments in the NAVSTA area is therefore 1500 + 600 kg Zn/ yr.

Finally, as mentioned above, blank tests of the prototype BFSD were conducted to determine the lowest levels of contaminants which could be resolved with the system. With the prototype BFSD prepared as it would be for a normal deployment, the test was conducted in seawater with the chamber sealed. A time-sequence for sample collection comparable to the planned deployments was used and the samples were analyzed identical to later site-collected samples. For the San Diego Bay tests discussed above the results were:

Coumpound	flux ± S.E.	(µg/m2/day)
	1993	1995
Cadmium	6 ± 7	5 ± 3
Copper	-71 ± 62	-2 ± 47
Iron	--	160 ± 235
Lead	-4 ± 8	7 ± 67
Manganese	--	-52 ± 26
Nickle	65 ± 69	-4 ± 27
Zinc	-227 ± 65	-149 ± 267

Whereas the prototype BFSD performed successfully and was considered mature enough to begin technology transfer, the process of data analysis and interpretation revealed complexities requiring careful consideration prior to reaching conclusions. Technology transfer, to be fully discussed in section 8, began with a competitively awarded firm-fixed-priced contract for Benthic Flux Sampling Device 2 (BFSD2), which incorporated a number of changes from the prototype BFSD. A series of

ex situ and *in situ* tests and tests and checkouts assured that the instrument retained critical prototype BFSD performance attributes as well as establishing functionality of the changed features. A complete series of laboratory (e*x situ*) tests and checkouts were conducted. *Ex situ* tests included: the new rotary valve sampling system to assure reliable performance; the pump and diffuser system with dye-dispersion to assure adequate mixing; the flow-through sensor system to assure responsive and accurate readings; the vacuum-filled, *in situ*-filtered sample bottles to assure clog-free operation and adequate fill volume; and the data acquisition and control system to assure required performance.

2. Technology Description

2.1 Description

Contaminants enter shallow coastal waters from many sources, including ships, shoreside facilities, municipal outfalls, spills, and non point-source runoff. Sediments are typically considered a primary sink for these contaminants. Where previous shoreside practices have resulted in high concentrations of contaminants in the sediments, contaminants may flux out of the sediments. Also, in areas where pollution prevention and remediation practices have removed other contaminant sources, remaining contaminated sediments may serve as a primary contaminant source to the water column.

To determine whether contaminants are moving into, out of, or remaining immobilized within the sediments, a determination of contaminant flux must be made. Diagenetic reactions in surface sediments control contaminant pore water gradients, and the direction and magnitude of these gradients control the diffusive flux across the sediment-water interface. These fluxes can be calculated from measurements of contaminant pore water gradients and sediment physical properties. However, in some coastal areas pore water gradients are very steep and therefore difficult to measure. In addition, flux calculations based on pore water gradients provide only the diffusive component of a contaminant flux. An additional concern in coastal areas is that biological irrigation by infauna and wave or current induced flushing may provide a larger component of flux through advection of water through the sediments. To avoid these problems, a direct measurement of contaminant flux in coastal areas is required to assess contaminant mobility across the sediment-water interface. This direct measurement can be made with a flux chamber that isolates a volume of seawater over the sediments to quantify contaminant flux across the sediment-water interface.

The Navy-designed and developed, contractor-fabricated Benthic Flux Sampling Device 2 (BFSD2) is a flux chamber designed specifically for *in situ* measurement of contaminant fluxes in coastal areas. A chamber of known volume encloses a known surface area of sediment. Seawater samples are collected periodically at timed intervals. After a laboratory has analyzed the samples, and with knowledge of the time intervals between samples, a flux rate between the sediment and water in mass per surface area per unit time (micrograms per square meter per day [$\mu g/m^2/day$]) can be calculated.

The BFSD2, shown in Figure 4 with key components labeled, consists of an open-bottomed chamber mounted in a modified pyramid-shaped tubular framework with associated sampling gear, sensors, control system, power supply, and deployment and retrieval equipment. The entire device is approximately 1.2 by 1.2 meters from leg to leg and weighs approximately 175 pounds. The lower part of the framework contains the chamber, sampling valves, sampling bottles, and batteries. The upper frame includes a release that is acoustically burn-wire triggered. The BFSD2 is designed for use in coastal and inland waters to maximum depths of 50 meters. Maximum deployment time is approximately 4 days based on available battery capacity. Figures 5 and 6 illustrate the two basic configurations for landing and sampling events, respectively.

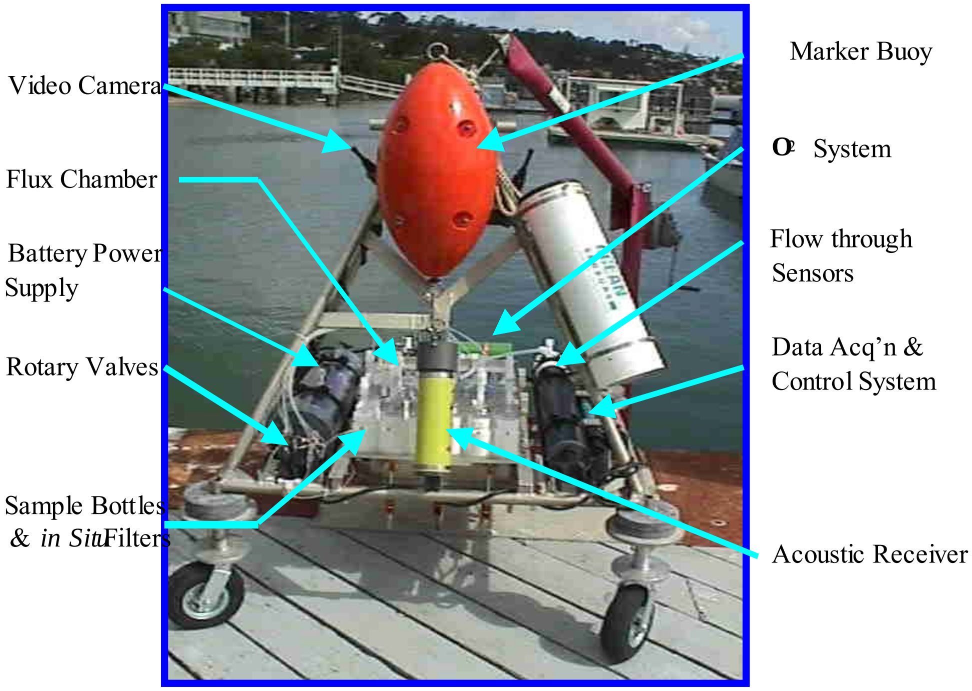
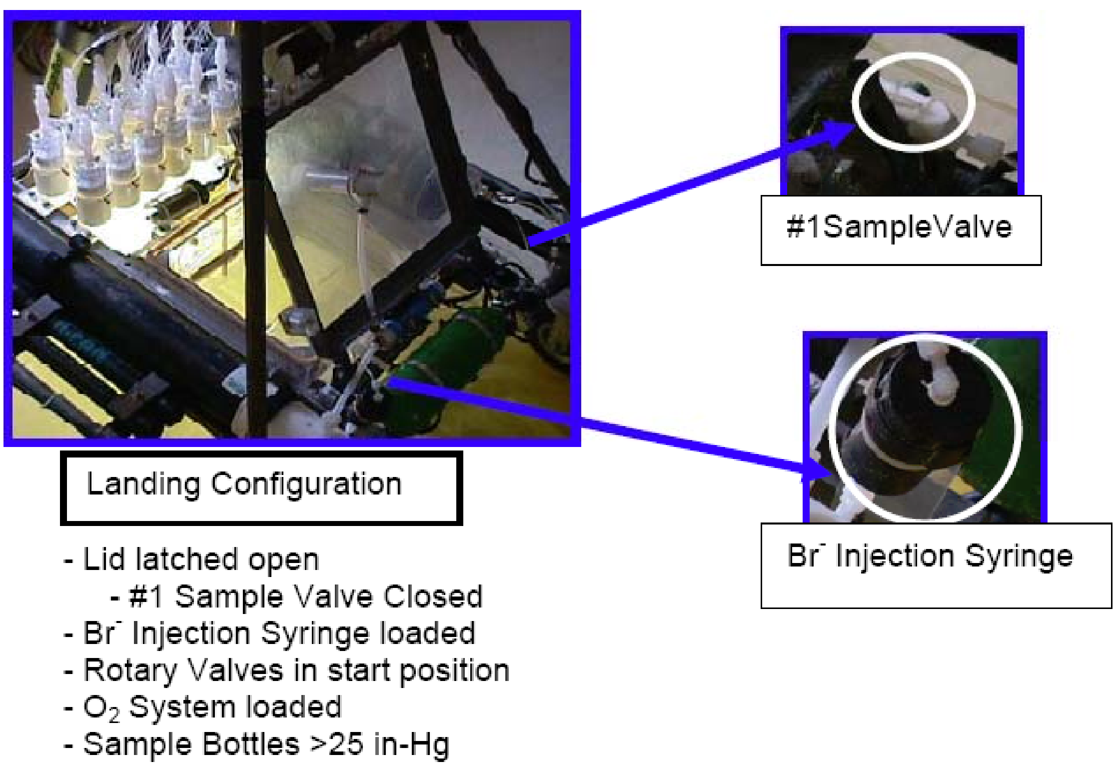


Figure 4. Benthic Flux Sampling Device 2.

Figure 5. BFSD2 Sampling Events.



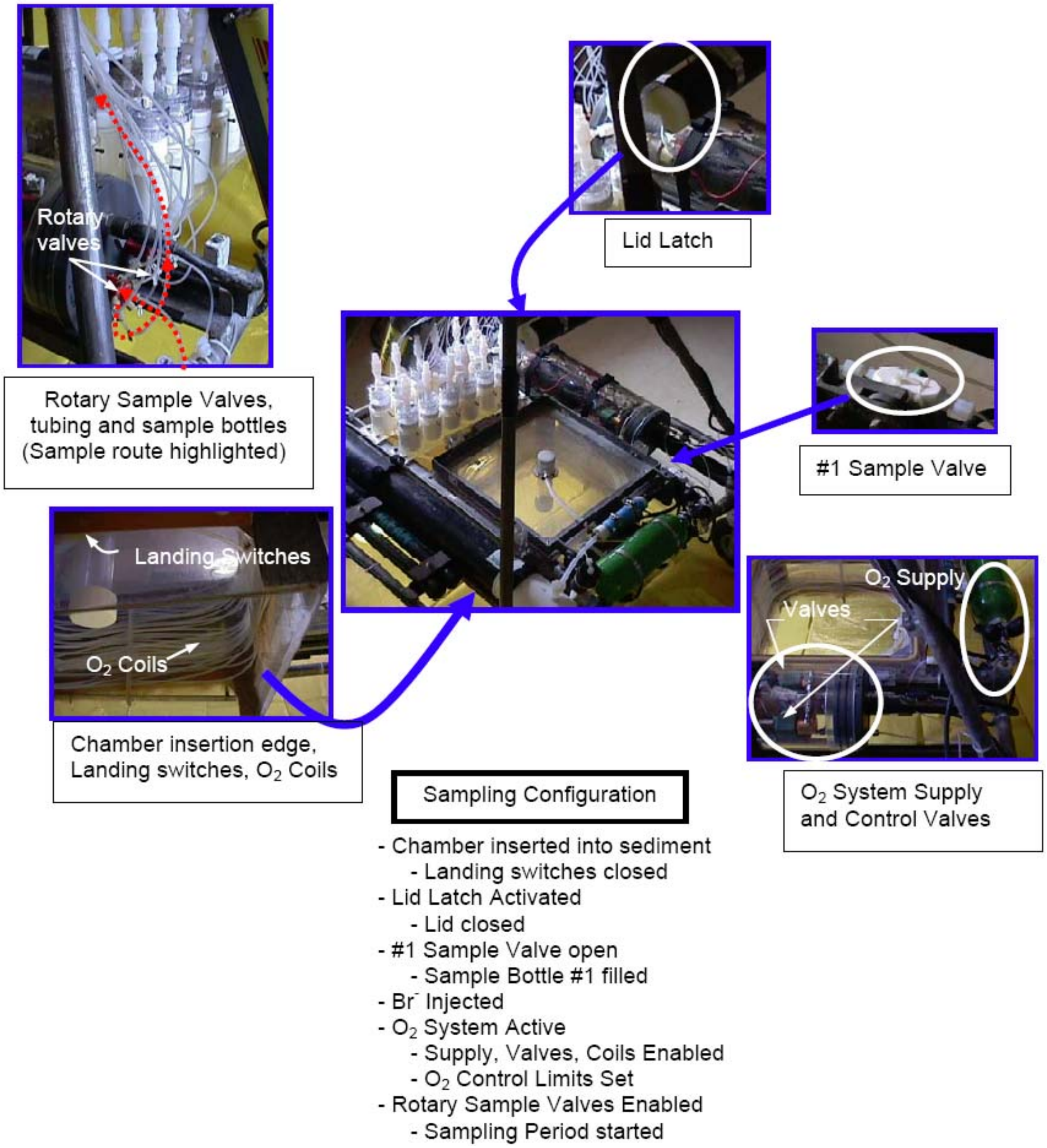


Figure 6. BFSD2 Sampling Events.

2.1.1 Sampling Chamber

The chamber is a bottomless box, approximately 40 centimeters (cm) square by 18 cm tall, with a volume of approximately 30.0 liters (Figure 7). The volume was chosen to allow for a maximum overall dilution of less than 10 percent due to sampling withdrawal into 11 samples of 250 milliliters (ml) each. For the combined demo, 11 combined samples were collected from within the chamber (100 mls for metals and 250 mls for PAH's) increasing the sample volume to 350 mls per sampling

event. This increased the dilution to about 13% for the combined sampling. The chamber is constructed of clear polycarbonate to avoid disrupting any exchanges that may be biologically driven and, thus, light sensitive. To prevent stagnation in the corners of the chamber, triangular blocks of polycarbonate occupy the 90-degree angles. The top of the chamber is hinged at one edge so that it may be left open during deployment to minimize sediment disturbance. Once the chamber is in place, the computer control system closes the lid. A gasket around the perimeter of the chamber ensures a positive seal between the chamber and the lid. Exact alignment is not required, because the lid is slightly larger than the sealing perimeter of the gasket and pivots on two sets of hinges. The lid is held closed by four permanent magnets situated along the chamber perimeter. The bottom of the chamber forms a knife-edge. Pressure-compensated switches mounted on the bottom surface of three sides of a flange circling the chamber at 7.6 cm above the base activate a series of three lights visible with a video camera mounted on the upper frame. Illumination of the lights indicate a uniform minimum sediment penetration depth has been achieved and a good probability that a positive seal between the chamber and the sediment has been achieved.

Figure 7. Chamber Enclosure.

Samples are drawn off through a 4-mm Teflon tube via synchronized parallel rotary valves and into evacuated 250 ml Teflon sampling bottles. For organics applications, standard precleaned 250 ml amber glass sample bottles with pre-combusted glass-fiber filter assemblies are used (Figure 8). For the combined demo, 100 ml Teflon bottles were used for metals and 250 ml amber glass bottles were used for PAH’s.

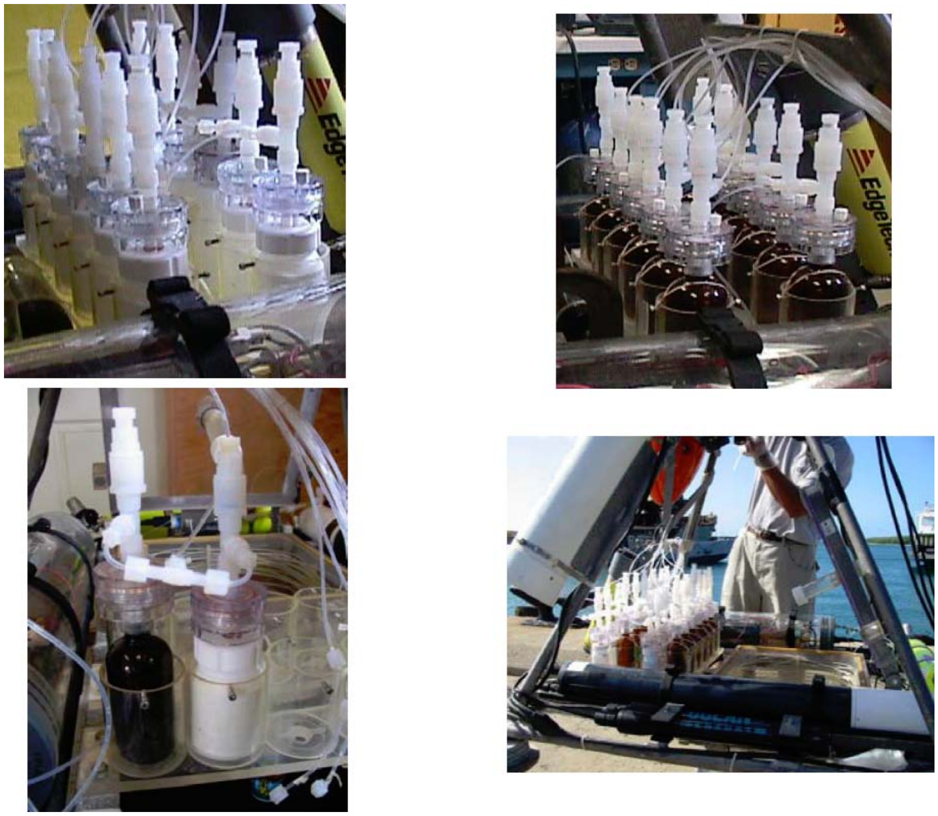


Figure 8. Sample Bottles. Clockwise from Upper Left, metals Bottles; Organics Bottles; Combined Metals and Organics Configuration; and Paired Bottles for Combined Deployment.

The first sample is drawn through a 0.45 micron-filter into the sample bottle upon closure of the lid at the start of the autonomous operation of the BFSD2; the remaining 11 samples are similarly collected as the synchronized parallel rotary valves are activated at preprogrammed intervals throughout the deployment. The bottles are evacuated to a minimum of 25 inches of mercury before deployment.

2.1.2 Acquisition and Control Subsystem

The acquisition and control unit is an Ocean Sensors Model OS200 conductivity temperature depth (CTD) instrument, modified to allow control of the BFSD2. It consists of a data logger that acquires and stores data from sensors, and a control unit that regulates sampling and other functions of the BFSD2. The data logger collects data from a suite of sensors housed in the CTD and connected to the chamber through a flow-through loop. A small constant-volume pump maintains circulation in the flow-through system to the sensors and is also used to maintain homogeneity of the contents of the chamber utilizing a helical diffuser mounted vertically on the central axis of the box. The control unit closes the lid, activates the flow-through/mixing pump, activates dissolved oxygen control valves, and controls activation the synchronized parallel rotary sampling valves. Commercial sensors, installed by Ocean Sensors, Inc., are mounted in the CTD instrument housing, and are connected to the chamber by means of a flow-through pump and circulation plumbing. Sensors are used for monitoring conditions within the chamber, including conductivity, temperature, pressure, salinity, pH, and dissolved oxygen, Figure 9. Circulation in the flow-through sensor system is maintained using a constant flow rate pump adjusted to approximately 15 milliliters per second (ml/sec).

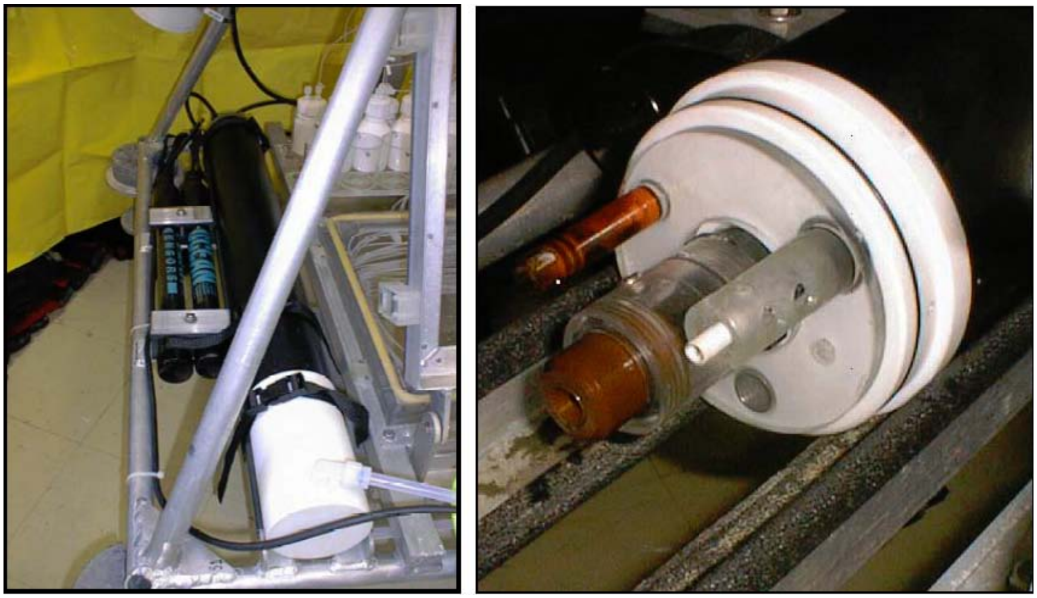


Figure 9. Flow-Through Sensor System.

2.1.3 Sampling Subsystem

Discrete samples are obtained using a vacuum collection approach consisting of sample containers, fill lines, in-line filters (with 0.45 micron membrane filters for metals or with 1.0 micron pre-combusted glass-fiber filters for organics), check valves, and synchronized parallel rotary valves connected to the chamber fill line. Off-the-shelf 250ml Teflon (metals) or amber-glass (organics) collection bottles are modified to allow filling through the cap. Sampling containers of any volume, material, or shape may be used, provided the cap can be modified to accept the fill line connection, the bottle wa lls are strong enough to withstand the pressure at the sampling depth, and the cap sea l is airtight and watertight at the sampling depth pressure. Glass, Teflon, and polycarbonate bottles have been tested and used successfully with the prototype BFSD. All valves, fittings, and tubes are made of Teflon or other nonmetallic materials to minimize potential metal contamination of samples and to facilitate cleaning. Samples are drawn from the chamber through a 4-mm Teflon tube connected to the rotary valves and into the sampling bottles. Sampling is initiated by the control system when it activates the valves at preprogrammed intervals. Seawater samples are drawn through the sampling system by a vacuum of 25 inches of mercury (minimum) which is applied to all sample bottles through check valves mounted in the bottle lids. The check valves are then sealed, and water enters each sample bottle when the rotary valves are activated (number 2 through 12) or when the lid closes and opens a valve attached to its hinge (number 1). Filtered seawater flows into each bottle until pressure is equalized, normally yielding at least 240ml.

2.1.4 Circulation Subsystem

The BFSD2 has a mixing area called the collection chamber and the process of interest is the exchange of chemical contaminants at the sediment-water interface sequestered within the chamber. The hydrodynamics inside the chamber must adequately simulate movement of water from near-bottom currents outside the chamber. For this purpose, a helical diffuser mounted vertically on the central axis of the chamber is used to mix the enclosed volume. Tests recorded on video verified that the helical diffuser provided a uniform, gentle mixing action that effectively dispersed dye injected into the chamber without disturbing the sediment layer on the chamber bottom.

The diffuser system includes a standard constant-volume submersible pump. The pump circulates water from an outlet in the chamber wall, into the sensor chamber and over the flow-through sensors, and back into the chamber via a rigid polycarbonate tube. The vertically mounted tube is capped at the discharge end and has 5mm holes drilled in a helix pattern along its length. The tests verified that this method visually dispersed a dye injection of Rhodamine in less than 120 seconds.

The acquisition and control unit, the oxygen supply bottle, a video camera and lighting system, circulation pumps, and the retrieval line canister are mounted on the frame members. The oxygen system is used to maintain aerobic conditions within the chamber by diffusing oxygen at a rate sufficient to maintain the initial dissolved oxygen levels through a coil of thin-walled, oxygen-permeable Teflon tubing.

2.1.5 Oxygen Control Subsystem

Over the course of an experiment, conditions in the isolated volume of seawater within the flux chamber begin to change from the initial conditions observed in the bottom water. Oxygen content is one factor that changes rapidly because isolated volumes of seawater in contact with the sediment surface will become anoxic without any resupply of oxygen. Since the fluxes of many contaminants, especially metals, are sensitive to redox conditions, the oxygen content is one of the most important factors that must b e monitored and regulated within the flux chamber. Most contaminant fluxes are not large enough to be measured in chambers without oxygen regulation because the isolated volume of seawater will become anoxic before significant contaminant fluxes have occurred. Because of this, an oxygen control system has been built into the BFSD2. This system maintains the oxygen levels in the chamber within a user-selected window about the measured bottom water oxygen level.

The oxygen regulating system consists of a supply tank, pressure regulator, control valves, diffusion coil, oxygen sensor, and control hardware and software. The supply tank is a 13-cubic foot aluminum diving tank equipped with a first-stage regulator that allows adjustment of output pressure to the system. The control valves are housed within a watertight pressure case with connections through bulkhead fittings on the end cap. The diffusion coil is thin-walled, 4-mm, oxygen-permeable, Teflon tubing approximately 15 meters (m) long. Oxygen is monitored using the oxygen sensor in the flow-through system described previously. The oxygen control valves (pressurize or vent) activation is incorporated into the control system of the BFSD2.

During a typical deployment, when the flux chamber is initially submerged, the ambient oxygen level in the water is measured with a control program which activates the circulation subsystem and sensors until a stable value of ambient oxygen concentration is obtained. This is performed with the BFSD2 either on the bottom or suspended less than 1 meter above the sediment (with the lid open). When oxygen stability is obtained, the user then establishes a maximum and a minimum oxygen control level, based on a userspecified range around the stable ambient level. Figure 10 is a typical set of data obtained from 15 minutes of operation. The control limits are entered into the operational control program and downloaded to the BFSD2 acquisition and control subsystem. When autonomous operations are started and the chamber is closed and sealed, the oxygen level inside the chamber is monitored by the control program. If the level drops below the allowable minimum, a control valve is momentarily opened, the diffusion coil is pressurized, and the oxygen level in the chamber begins to increase. When the oxygen level reaches the maximum allowable level, another control valve is activated and the pressurized tubing is vented. This sequence is repeated continuously during deployment, maintaining the oxygen level in the chamber near the ambient level. Figure 11 is a typical set of data obtained from a 72-hour deployment. Note that dissolved oxygen concentrations are reported in ml/l in this report. Dissolved oxygen concentrations in seawater can

be expressed in millimolar, uMoles/kg, mg-atoms/liter, mg/liter, ml/liter or percent saturation. Conversion from mg/l to ml/l is a linear computation (mg/l x 1.4276 = ml/l). It is true Standard Methods suggests re porting in mg/l, however different reporting units are found in the literature. We have historically used oxygen sensors obtained through Seabird Electronics, and their calibration procedures and software all use ml/l for dissolved oxygen concentrations.

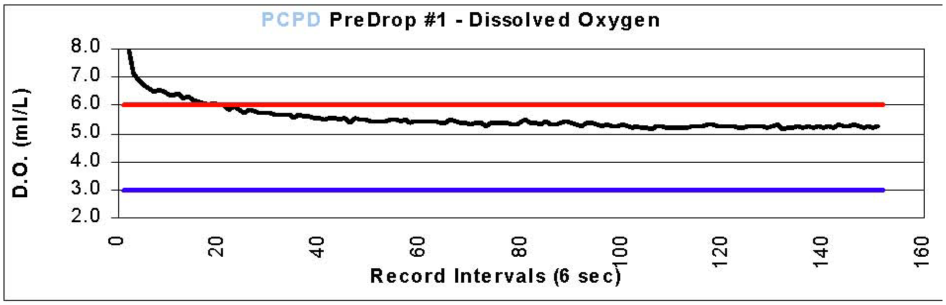


Figure 10. Ambient Oxygen Data.

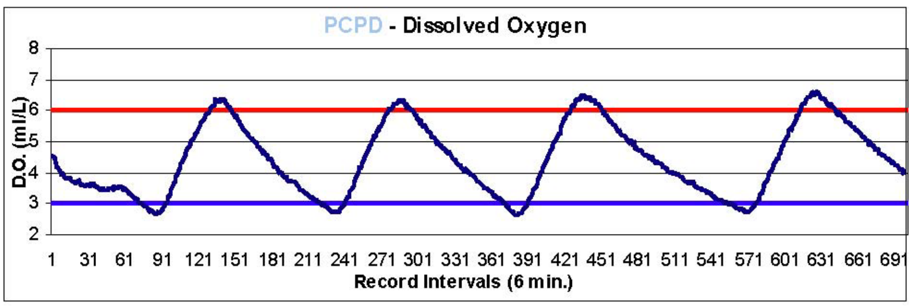


Figure 11. Operational Oxygen Control Data.

2.1.6 Deployment and Retrieval Subsystems

During deployment the test site is surveyed for obstacles with a light-aided video camera mounted on the upper frame of the BFSD2 using a on deck television monitor. As shown in Figure 12, a deployment cable and release line are used to lower the BFSD to its intended depth for the video inspection. Following either rapid or slow descent to the bottom, the minimum depth of collection chamber insertion is sensed by pressure-compensated switches, which activate lights mounted on the chamber frame. These lights are TV-monitored on deck.

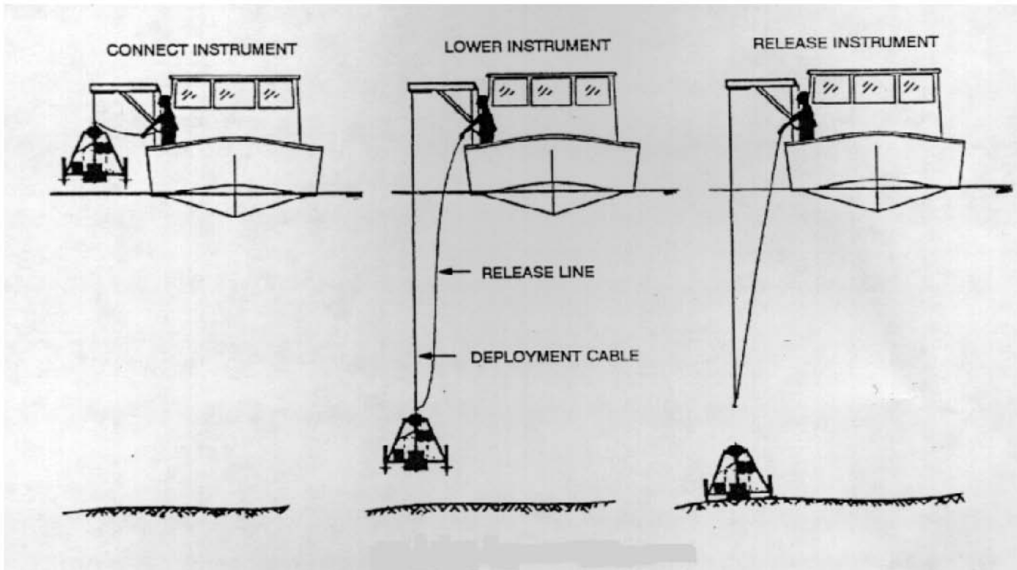


Figure 12. BFSD Deployment.

Recovery is accomplished by transmitting a coded acoustic signal to the frame-mounted receiver which in turn releases the marker buoy, Figure 13. As shown in Figure 14, the line attached to the buoy is used to lift the BFSD2 aboard the vessel. Stored sensor data is uploaded before the detaching cables.

Figure 13. Acoustic Release and Retrieval Buoy.

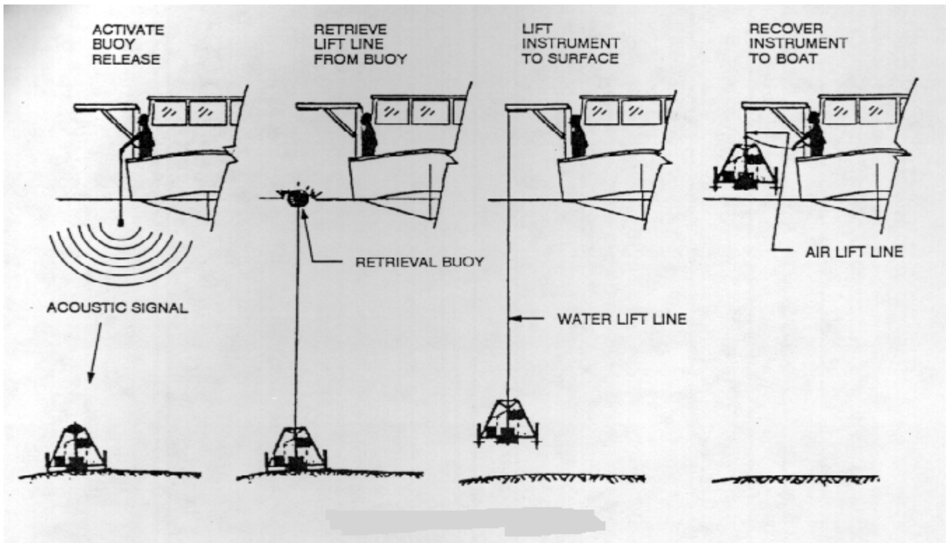


Figure 14. BFSD Retrieval.

2.1.7 Analytical Methods

2.1.7.1 Cleaning

Prior to each deployment, the BFSD2 sample collection system is cleaned and decontaminated. A sequential process of flowing cleaning fluids through the sampling subsystem using vacuum; of soaking disassembled parts (collection bottles and other parts) in prepared solutions; of physically brushing and rinsing the collection and sensor chambers and the circulation subsystem with prepared solutions is followed. For metals, a nitric acid soak/rinse is used before a final rinse with 18 meg-ohm de-ionized water and for organics a methanol rinse with air dry is used prior to sealing/closing off all paths of contamination until deployment.

2.1.7.2 Performance Indicators

A series of performance indicators are used to evaluate the data obtained during operational deployments. One performance indicator is the chemistry time-series data for silica. Silica, a common nutrient used in constructing the hard parts of some planktonic organisms, typically shows a continuous flux out of the sediments due to degradation processes. The linear increase in silica concentration with time in the collected sample bottles is therefore used as an internal check for problems such as a poor chamber seal at the lid or sediment surface. A field analytical test set (Hach Model DR2010) is used to assess the silica concentrations immediately following retrieval and before sending collected samples to the analytical laboratory. Figure 15 is an example of silica flux indicating an adequate chamber seal with the sediment. Also, with a good chamber seal the ongoing bacterial degradation of organic material in the sediment consumes oxygen (which must be regulated by the BFSD2) and also generates carbon dioxide. This gradually lowers the chamber pH and Figure 16 is an example of this data for a good chamber seal with the sediment.

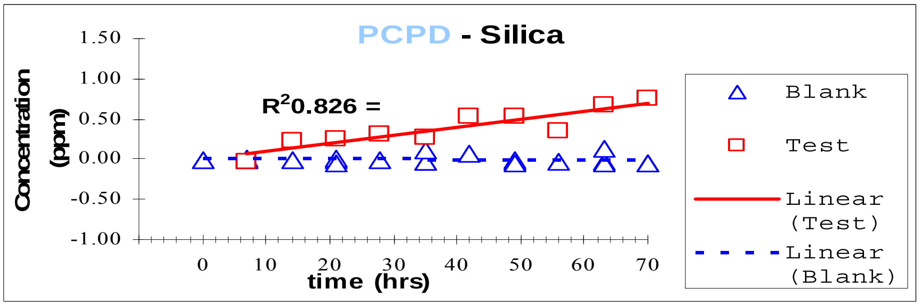


Figure 15. Silica Flux for Good Chamber Seal.

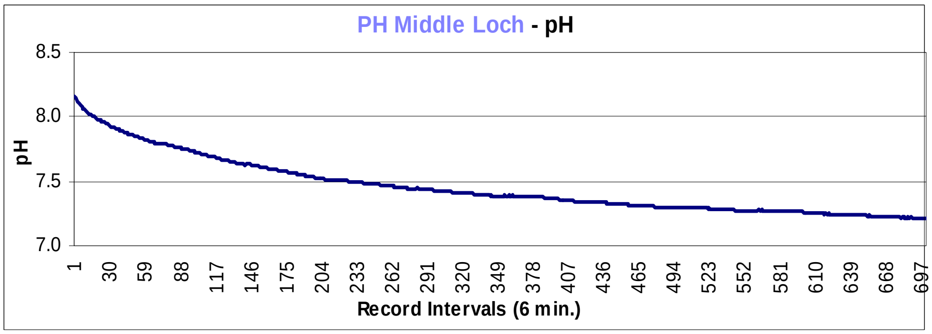


Figure 16. pH Data for Good Chamber Seal.

Although the expected relationships of these performance indictors aid in determining normal or successful deployments, natural variability is always present to cloud these relationships. Variations in the pore water reactions at the various sites lead to differences in the observed fluxes of oxygen, silica, and also the other contaminants. One major factor contributing to the large variations in fluxes may be burrowing activity. Enhanced biological irrigation (pumping of the overlying seawater through sediment burrows by infaunal organisms) increases the surface area of the sediment-water interface and flow rates across the interface, and may also increase the observed fluxes. The organisms responsible for this biological pumping will also affect oxygen uptake rates and may add to the complex interpretation of the analytical results.

2.1.7.3 Blank Tests

Prior to the BFSD2 demonstrations, a triplicate blank test was performed to determine the lower limit of resolution for flux determinations of various metals. A polycarbonate panel was sealed across the bottom of the chamber and the BFSD2 was lowered to within several meters of the sediment surface. A standard operational program identical to the demonstration deployments was run for 70 hours. The results will be presented later in this report.

2.1.7.4 Computations

Fluxes are computed from the trace metal concentrations in each sample bottle using a linear regression of concentration versus time after the concentrations are corrected for dilution effects. These dilution effects result from intake of bottom water from outside the chamber to replace the water removed for each collected sample. The corrected concentrations are obtained from the following equation:

$$[C_n] = [s_n] + \frac{v}{V}\left(\left(\sum_{i=1}^{n-1}[s_i]\right) - (n-1)[s_0]\right)$$

Where **[*C*]** is the corrected concentration, **[*s*]** is the measured sample concentration, ***n*** is the sample number (1 through 6), ***v*** is the sample volume, and ***V*** is the chamber volume. Fluxes are then calculated as follows:

$$Flux = \frac{mV}{A}$$

Where ***m*** is the slope of the regression of concentration versus time, ***V*** is the chamber volume, and ***A*** is the chamber area.

An interactive computational spreadsheet processes most data. Analytical laboratory results, sensor and other measured data, performance indicator results and blank test results are entered into the spreadsheet template and processed. A series of tables, charts and graphs are computed and displayed, including statistical confidence and other figures of merit. Appendix C provides a set of spreadsheet products for each demonstration.

2.2 Strengths, Advantages and Weaknesses

2.2.1 Strengths

The BFSD2 is an *in situ* technology. Benthic contaminant fluxes can provide a unique *in situ* measure of contaminated sediments as well as an indication of bioavailability. Many of the disadvantages cited for various approaches towards assessing sediment contamination relate to removal of the contaminated material to the laboratory for chemical and biological assays. In concert with traditional monitoring and assessment techniques, these flux measurements can lead to a better understanding of marine sediment contamination and transport mechanisms.

2.2.2 Advantages

The BFSD2 is an easily implemented technology, as it is readily deployed from a small boat, and all sampling, data logging, and control functions are carried out automatically based on preprogrammed parameters. The BFSD2 can be used to collect samples without diver assistance to minimize costs, time necessary for sampling, and safety issues associated with sampling activities. Furthermore, the system is able to collect a wide range of contaminants, nutrients, and dissolved gases and it is operational under a wide range of environmental conditions. All materials used in the system are suitable for use and prolonged exposure in the marine environment.

Results obtained using the BFSD2 can be used for the following purposes:

- Source quantification for comparison to other sources and input to models
- Indication of bioavailability since many studies indicate that resolubilized contaminants are more readily available for uptake
- Determination of the cleansing rate of a contaminated sediment site due to natural biogeochemical cycling of the in-place contaminants
- Provision of a nonintrusive monitoring tool for sites that have been capped or sealed to minimize biological exposure

- Testing and validation of hypotheses and models for predicting the response of marine sediments to various contaminants.

2.2.3 Weaknesses

One limitation is a lower limit on the flux rates that can be calculated from data collected using the BFSD2 system. Also, the BFSD2 may be deployed to a maximum depth of 50 meters and the maximum deployment is approximately 4 days, based on available battery capacity. The BFSD is stable in bottom currents up to 3 knots.

2.3 Factors Influencing Cost and Performance

2.3.1 Cost influences

The factors influencing cost include, in order:

1. Analytical laboratory costs: laboratory analysis of samples by highly specialized analytical laboratories accounts for approximately 50% of total BFSD2 project costs.

2. Blank tests: the larger the number of sites within a common bay, harbor or other defined location the smaller the proportional cost per site for blank tests. It may be possible to eliminate blank testing in some cases, but a cost approaching 50% could occur for only one deployment.

3. Remote location: Acquisition of local resources such as a surface vessel configured with a davit or A-frame and equipment shipping costs most influence total project costs. Transportation, per diem, materials and supplies are equivalent for all sites other than local. Labor costs are the same.

4. Work schedule: Limited site access or availability can influence cost. Without such restraints a work schedule taking advantage of *in situ* BFSD2 deployment periods over weekends and/or to accomplish cleaning, sample handling, and other turnaround preparations can be instituted. Extended work hours can be compensated with offsetting periods of inactivity.

2.3.2 Performance Influences

The factors influencing performance include:

1. Sediment physical conditions: The BFSD2 requires a collection chamber seal with the sediment to function properly. The primary cause for lack, or loss of seal is porosity of the sediment due to large grain size and distribution. An entire deployment can be lost under extreme conditions, however the use of performance indicators can avoid analytical laboratory costs by identifying such cases immediately after retrieval.

2. Sediment contamination levels: The lower limit for resolving significant flux levels is based on blank test results. Sites having contaminated sediment levels lower than blank test results cannot be resolved with a high degree of confidence. Such results are reported as statistical probabilities with confidence limits and are typically well below water quality limits and do not lead to cleanup issues.

3. Site marine conditions: As with 1. above (sediment-chamber seal), the BFSD2 also must also maintain a good chamber-lid seal. Surface vessel turbulence and/or prop wash, tidal and/or local currents, or even large fish disturbances can jar the magnetically held lid. A momentary loss of the lid seal can allow ambient seawater to enter the chamber and refresh sequestered sample water. Although such an event will be detected by the previously discussed performance indicators, some or all of the deployment can be negated by loss of lid seal.

3. Site/Facility Description

3.1 Background

Two locations were selected for BFSD2 demonstrations. The first was San Diego Bay, California (Paleta Creek area); and the second was Pearl Harbor, Hawaii (Middle Loch and Bishop Point). The locations/sites were selected based on the following criteria:

1. (metals) The sites were known to have metal-contaminated marine sediments, and had been at least partially characterized. The sediment contaminant levels were anticipated to be high enough to demonstrate statistically significant fluxes at the sediment-water interface.

2. (metals) Two deployments at the same San Diego Bay, Paleta Creek site would demonstrate repeatability; two deployments at geographically different Pearl Harbor sites would demonstrate characteristically different data and showcase analysis/interpretation results.

3. (metals) The contaminated sediments were located in shallow areas (less than 50 meters deep) and readily accessible.

4. (metals) Demonstration logistical support requirements would be demonstrated by deployments in Pearl Harbor.

5. (metals) Data from prototype BFSD deployments conducted at the Paleta Creek site were available for use as reference data and for comparison with demonstration results (See section 1.5).

6. (organics) Both sites were known to also have organics-contaminated sediments and other demonstration factors were already achieved.

3.2 Site/Facility Characteristics

3.2.1 San Diego Bay, California

With no major inputs of fresh water, the currents and residence time of water in San Diego Bay are tidally driven. The average depth of the bay is about 5 meters. The tidal range from mean lower-low water to mean higher-high water is about 1.7 meters. The maximum tidal velocity is about 0.05 to 0.1 meters per second. Sediment pore waters in San Diego Bay typically become anoxic several millimeters below the sediment surface. Dissolved oxygen concentrations range from 4 to 8 milliliters per liter; sea water pH varies from 7.9 to 8.1; and temperatures range from 14 to 25°C.

The sediments of San Diego Bay consist primarily of gray, brown, or black mud, silt, gravel, and sand. The sources of contamination in San Diego Bay have varied over time and include sewage, industrial wastes (commercial and military), ship discharges, urban runoff, and accidental spills. Current sources of pollution to San Diego Bay include underground dewatering, industries in the bay area, marinas and anchorages, Navy installations, underwater hull cleaning and vessel antifouling paints, and urban runoff. Known contaminants in the bay include arsenic, copper, chromium, lead,

cadmium, selenium, mercury, tin, manganese, silver, zinc, tributyltin, polynuclear aromatic hydrocarbons (PAH), petroleum hydrocarbons, polychlorinated biphenyls (PCB), chlordane, dieldrin, and DDT.

The Paleta Creek site, Figure 17, is located in San Diego Bay in San Diego County, California, adjacent to Naval Station San Diego. The Paleta Creek site is located on the western shore near Naval Station San Diego where Paleta Creek empties into the bay, slightly inland from the Navy Pier 8 and Mole Pier and north of Seventh Street. Naval Station San Diego began operations in 1919 as a docking/fleet repair base for the U.S. Shipping Board. In 1921, the Navy acquired the land for use as the San Diego Repair Base. From 1921 to the early 1940s, the station expanded as a result of land acquisitions and facilities development programs.

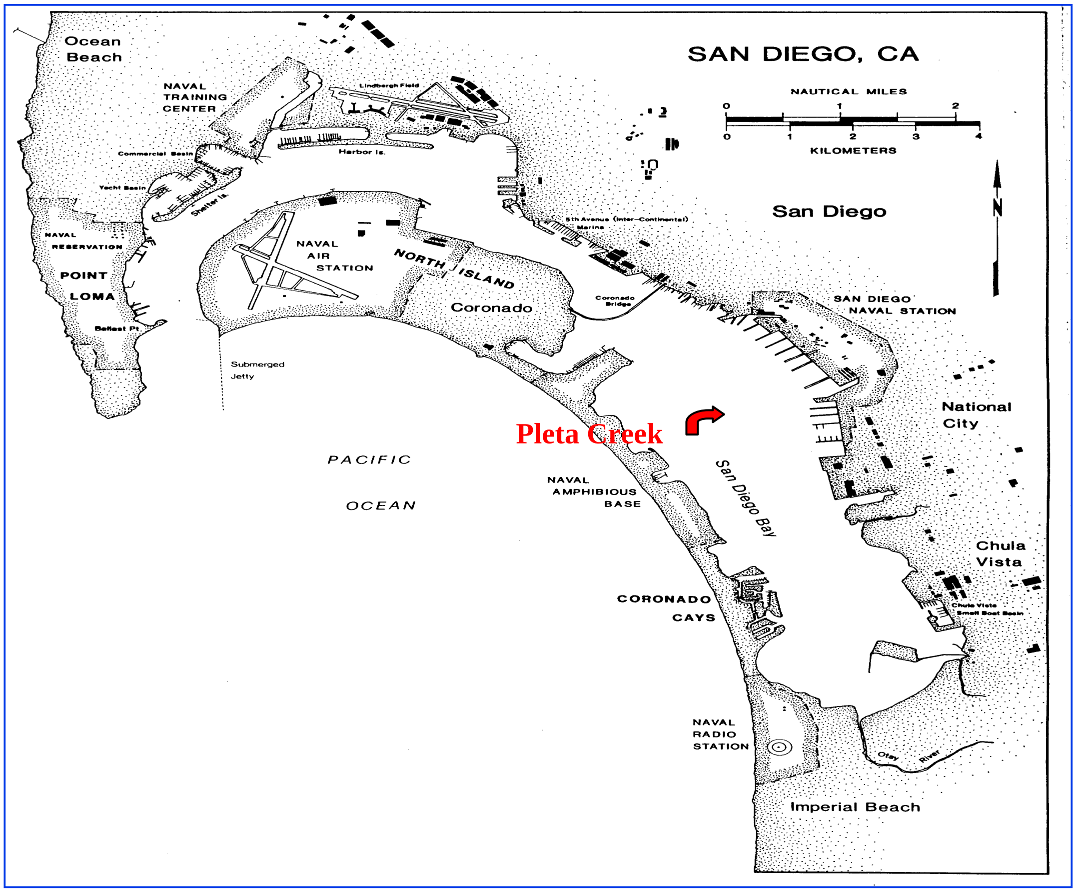


Figure 17. San Diego Bay, Paleta Creek Site.

3.2.2 Pearl Harbor, Hawaii

Pearl Harbor contains 21 square kilometers of surface water area; the mean depth is 9.1 meters. Tidal flow and circulation are weak and variable, with a mean tidal current velocity of 0.15 meter per second and a maximum ebb flow of 0.3 meters per second in the entrance channel. Salinity in Pearl Harbor ranges from 10 to 37.5 parts per thousand, with a yearly average of 32.8 parts per thousand. Harbor water temperatures annually range from 22.9 to 29.4°C, and dissolved oxygen values range from 2.8 to 11.0 milligrams per liter. Pearl Harbor is most appropriately described as a high-nutrient estuary.

Middle Loch is located in the northwestern end of Pearl Harbor, north and west of Ford Island, within the Pearl Harbor Naval Base, see Figure 18 below.

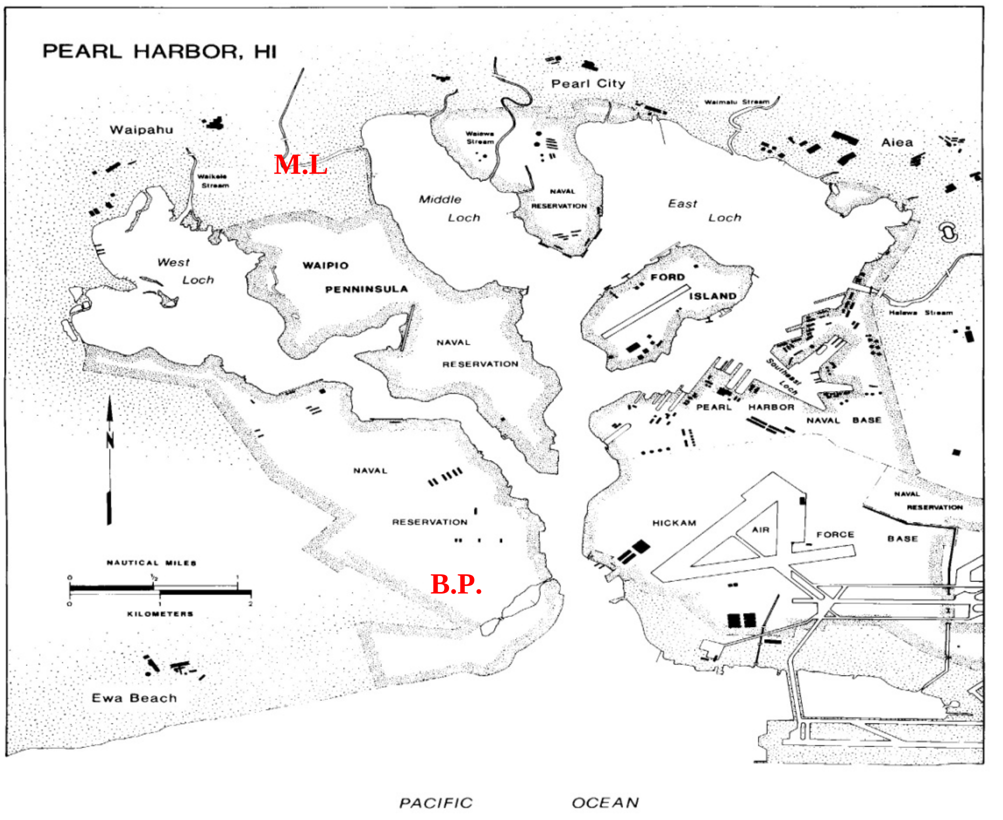


Figure 18. Pearl Harbor, Hawaii Middle Loch Bishop and Point Sites.

In 1901, the U.S. Navy acquired 800 acres of land to establish a naval station at Pearl Harbor. The Pearl Harbor Naval Base has existed since 1919. During World War I, about 12 warships were repaired and overhauled at the Navy Yard. In 1917, a temporary submarine base was relocated to the eastern shoreline of Southeast Loch. Industrial development in the vicinity of Pearl Harbor was greatly accelerated during the late 1930s and early 1940s. During the 1941 Japanese attack on Pearl Harbor during World War II, 21 of the U.S. ships in Pearl Harbor were sunk or severely damaged, and debris resulting from this attack remains buried in harbor sediments (despite initial cleanup efforts). Currently, Pearl Harbor is a major fleet homeport for nearly 40 warships, service-force vessels, submarines, and their associated support, training and repair facilities.

Middle Loch is moderately contaminated with heavy metals as well as with toxic organic compounds and hydrocarbons. Sediments contain various concentrations of metals such as silver, arsenic, cadmium, chromium, copper, iron, mercury, manganese, nickel, lead, and zinc. Toxic organic compounds include pollutants such as solvents, paints, pesticides, and PCBs. Hydrocarbon contaminants include all petroleum-based fuel products such as diesel, JP-5, JP-4, bunker fuel, gasoline, oils, sludges, and lubricants. Bishop Point is an active industrial area with ongoing salvage operations and related ship movements. Sediments contain similar contaminants as mentioned above but at higher levels.

4. Demonstration Approach

4.1 Performance Objectives

The demonstrations were intended to verify the performance of the BFSD2 by assessing whether chemicals are adsorbing to or desorbing from sediments at the sediment-water interface. Specifically, the objectives of the BFSD2 technology demonstrations were to:

(1) Evaluate the data quality of the water samples collected for use in determining if a statistically significant flux was occurring at the test locations.

(2) Evaluate the BFSD2 for repeatability.

(3) Evaluate the logistical and economic resources necessary to operate the BFSD2.

(4) Evaluate the range of conditions in which the BFSD2 can be operated.

In order to determine whether statistically significant fluxes were occurring at the test locations (Objective 1), 12 seawater samples were collected at 7-hour intervals using the BFSD2. For metals, the water samples were analyzed for cadmium, copper, manganese, nickel, lead, zinc and silica. For organics, the samples were analyzed for EPA priority PAHs, PCBs and pesticides. For metals, sediment samples, when collected, were analyzed for grain size, total solids, total organic carbon (TOC), acid volatile sulfide (AVS), simultaneously extracted metals (SEM), and total metals. Although the sediments may have been contaminated with other constituents, only the flux of the listed metals was evaluated during the demonstrations. For organics, sediment samples were analyzed for the same analytes as the associated water samples.

In addition, other metals including antimony, arsenic, selenium, silver, thallium, and iron were analyzed in the seawater samples collected during the three blank chamber tests. This data will be used at future dates when establishing baseline performance for these metals.

Sample concentrations were corrected for dilution introduced by the sampling process, and a regression curve was generated for each analyte based on the concentration data. Flux rates, with regression coefficients, were compared to the composite flux rate and standard deviation determined for each metal or organic during triplicate blank chamber tests. The measured flux rate for each metal or organic was then evaluated to assess if a statistically significant flux had been measured when compared to the blank chamber (background) test. The BFSD2 was evaluated for repeatability (Objective 2) by analyzing the metals results of repeat deployments, two weeks apart, at the same Paleta Creek site. Demonstration data was also compared to data from the site during previous prototype BFSD tests in the same approximate location. Finally, repeatability was evaluated by comparing the results from three blank chamber deployments for both metals and organics. The logistical and economic resources necessary (Objective 3) were evaluated by documenting costs associated with planning, scheduling and executing the demonstration deployments, laboratory analysis, data management, and report preparation. Lastly, the range of conditions for operating the BFSD2 were evaluated

(Objective 4) by describing the conditions under which the BFSD2 operated and the projected range of contaminants applicable to the technology.

The demonstration approach was to collect time series of water samples using the BFSD2 at two geographically different locations. For metals at the San Diego Bay location (Paleta Creek) two deployments at the same site were made; at the Pearl Harbor location, one deployment at each of two geologically different sites were made (Middle Loch and Bishop Point). Comparison of the results of the two Paleta Creek demonstrations to one another was intended to evaluate repeatability of the technology. Comparison of the results from the two geographically different sites in Pearl Harbor was intended to demonstrate data differences and analysis/interpretation approaches. Comparison of the Pearl Harbor data as a whole with that from San Diego also demonstrated geological differences between continental shelf and mid-Pacific riff measurements. For organics, one Paleta Creek deployment and one Bishop Point, Pearl Harbor deployment were performed to demonstrate the extended performance. For both metals and organics three "blank test" deployments were conducted, during which the BFSD2 was deployed in seawater with a sealed sampling chamber. Three time series of samples were collected and a baseline was established for each analyte, which provided a statistical estimate of the lower limit of flux detection measurable with the BFSD2. The data also served as another measure of precision and repeatability. Previous metals results obtained at the same location using the prototype BFSD also provided a general measure of trend repeatability. A rate of flux between the sediment and the water for each analyte for each deployment was calculated. The flux rate was calculated using knowledge of the volume of water enclosed within the BFSD2, the surface area of sediment isolated, the time the samples were collected, and the concentrations of the contaminants of interest in the individual sample. Because this technology has no current equivalent, the BFSD was evaluated based on the internal QA/QC of the laboratory analysis and an analysis of the data.

4.2 Physical Setup and Operation

4.2.1 Physical Setup

Deployment preparations included BFSD2 maintenance, decontamination and setup. Maintenance included inspection and repair due to leakage or corrosion, inspection of sealing surfaces, seals and o-rings, inspection and replacement of sacrificial zinc anodes, downloading and/or deleting unnecessary files in the memory-limited control and data acquisition subsystem, and inspection of any worn or other potentially failure prone areas.

Decontamination involves soaking and/or rinsing all surfaces contacting seawater samples in a series of fluids beginning with tap water, then de-ionized water, then a special detergent ("RBS"), then de-ionized water, then nitric acid for metals or Methanol for organics, then 18 meg-ohm de-ionized water (metals) and finally filtered air. For metals, the collection bottles are disassembled and all component parts are soaked, four-hours minimum, in each fluid. A 25% concentration of ultra-pure nitric acid is used to soak Teflon™ parts (bottles, lids, and sensor chamber) and a 10% concentration is used for all other parts (including acid-sensitive polycarbonate filter bodies). For organics, components are rinsed with Methanol and air-dried and precleaned amber-glass sample bottles are used. The synchronized rotary valves, tubes and fittings remain assembled to the BFSD2 and are cleaned in place by flowing the series of decontamination fluids through them. The acquisition and control subsystem is used to execute a special program which activates each valve position for specified time during which the decontamination fluids are forced through by positive pressure using a Teflon-coated pump. And finally, the collection chamber, lid, diffuser, circulation pump, tubes and fittings are physically scrubbed and rinsed in place with non-metallic brushes. All decontaminated surfaces are dried, reassembled or otherwise sealed to isolate them from ambient, air-borne contaminants.

BFSD2 setup includes various tasks to be performed prior to deployment using checklists. These include: charging the gel-cell 24Vdc battery; replacing the 14 circulation subsystem C-cell batteries; replacing the 6 acoustic release 9Vdc batteries; installing a new acoustic release subsystem burn wire, cleaning the plating anode and rigging the recovery float; checking and refilling (if required) the compressed-oxygen supply tank; checking the insertion light subsystem function and replacing its one battery (if required); installing the 12 sample collection bottles and evacuating them to less than 25 in-Hg; setting up laptop computer files for post-deployment data uploading; reviewing and modifying, as required, the deployment operational control programs and downloading the predrop program into the acquisition and control subsystem.

4.2.2 Deployment

Each BFSD deployment requires at least three personnel. One person is responsible for maneuvering, positioning and securing the surface vessel. Two additional persons are required to deploy and retrieve the BFSD. The checklists included in appendix D are the step-by-step procedures followed on deck to avoid oversights and mistakes. Ancillary tasks to be performed include collection of a sediment sample with a spring-loaded grab sampler and logging site GPS coordinates. Figures 19 through 22 illustrate typical deployment and recovery scenes.

4.2.3 Recovery

Recovery is initiated following an elapse time after the planned deployment greater than the operational program by at least two hours. This allows for accumulated processing delays which lengthen the overall autonomous time period. Once within approximately 100 yards of the deployment position a coded acoustic signal is transmitted to the BFSD2 acoustic receiver from the deck unit. A 15-minute function time begins during which the burn-wire is consumed and the recovery buoy is released. The line attached to the buoy is used to wench the BFSD2 and the attached coiled cables to the surface and aboard the vessel. Heavy sediment and other debris are washed off the BFSD2 before bringing it onboard. On deck an inspection of collection bottle status is made as an immediate indicator of deployment performance. Turning the compressed-oxygen cylinder valve off and installing storage caps on the pH and oxygen sensors is also done without delay. Other assessments that may be accomplished onboard include upload of logged data from the acquisition and control subsystem and processing of pH and oxygen sensor data as performance indicators. Spreadsheet templates are used to quickly generate graphs and charts of converted and processed data which display results for the entire operational deployment. Aboard a properly configured surface vessel such as SSC SD’s R/V ECOS during the San Diego Bay demonstration sample handling such as acid preservation, labeling and sealing of 100 ml laboratory samples and 25 ml splits for measurement of silica concentration was accomplished. Once off loaded to shore, the BFSD2 must be thoroughly washed down with fresh water to remove all remaining debris, sediment and seawater and to minimize corrosion. As soon as practicable, a freshwater purge and forced-air dry of the synchronous rotary valves and associated tubes and fitting is accomplished.

Figure 19. Deployment Equipment **(**SSC SD Dock**).**

Figure 20. Crane Loading Aboard Workboat **(**Bishop Point, Pearl Harbor).

Figure 21 Deployment **(**Middle Loch, Pearl Harbor**).**

Figure 22. Recovery **(**Middle Loch, Pearl Harbor**).**

4.3 Sampling Procedures

The sampling procedures followed for the BFSD2 demonstrations provided assurance that the overall project goals and objectives were met. Careful adherence to the procedures ensured that data collected was useful in evaluating the effectiveness of the BFSD2 for benthic flux measurements.

4.3.1 Overview of Sampling Operations

Sampling operations at each demonstration location consisted of site deployments during which the BFSD2 collected seawater samples at timed intervals and a sediment confirmation sample collected following each site deployment. Three additional identical blank (background) deployments with the BFSD2 collection chamber sealed using a polycarbonate bottom plate were used to statistically establish system blank performance as a baseline for comparison to the sediment flux data.

4.3.1.1 BFSD2 Sampling

Samples were collected *in situ* in twelve 250-ml precleaned sampling bottles at preprogrammed time intervals. A description of the sampling technology can be found in Section 2.1. Sampling was initiated by starting the acquisition and control subsystem program, which activated synchronous rotary valves connected to the sample bottles. In-line filters passed only seawater with dissolved-phase contaminants at the time of collection. After each deployment, the samples for metals analysis

were transferred to appropriate sample containers and acidified, if necessary. Samples for organics analysis were collected in non-reusable bottles and shipped to the analytical lab without further disturbance. A baseline ambient water sample was collected as the number one BFSD2 sample during deployment. The sample was analyzed and used to establish the ambient concentration at time zero for each analyte. The total time required for the 12 sampling events including the time zero sample using 7-hour intervals was approximately 72 hours with consideration for accumulated data processing delays.

4.3.1.2 Sediment Sampling

A sediment sample was collected at the end of each different site deployment using a spring-loaded grab sampler. The sediment was containerized, capped, labeled, and sealed. The sediment samples were used in various analyses, including digestion and extraction processes to measure trace metal and organic levels. Other measurements related to seawater data analysis and interpretation were conducted and are reported in a later section.

4.3.1.3 System Blank Samples

With the BFSD2 configured as described in Section 2.1, three deployments using identical procedures were accomplished for both metals and for organics. The samples were collected and handled as in the demonstrations (see 4.3.1.1 above) and shipped to the analytical laboratory for the analyses discussed below.

4.3.1.4 Quality Control

Demonstration samples and blank samples included equipment blanks, trip blanks and laboratory blanks to assess the performance of the equipment in the field.

4.3.1.5 Communications and Documentation

The SSC SD program manager communicated regularly with demonstration participants to coordinate all field activities associated with the demonstrations and to resolve any logistical, technical, or QA issues that arose as the demonstrations progressed. Successful implementation of the demonstrations required detailed coordination and constant communication among all participants. Field documentation was included in field logbooks, field data sheets, chain-of-custody forms, and kept in a bound logbook. Each page was sequentially numbered and labeled with the project name and number. All photographs were logged by the digital camera and transferred to the computer file system. Those entries included the time, date, orientation, and subject of the photograph. Specific notes about each sample collected were written on sample field sheets and in the field logbook. Any deviations from the approved final demonstration plan were thoroughly documented in the field logbook and communicated to parties affected by the change. Original field sheets and chain-of-custody forms accompanied all samples shipped to the laboratory.

4.3.1.6 Field Sample Collection

Sampling personnel collected and prepared samples using the procedures described below. All field activities conformed with the requirements of the Demonstration Plan and its attached Health and Safety Plan. Sampling operations at each site consisted of a deployment of the BFSD to collect seawater samples at timed intervals, and collection of a sediment grab sample after deployments. The series of samples collected during three blank test deployments with the chamber sealed with a polycarbonate bottom were used to assess the background level from which statistically significant fluxes can be derived.

4.3.1.6.1 Field Blanks

One field blank for the San Diego Bay metals demonstration consisted of an additional 250-mL bottle filled with de-ionized water strapped to the flux chamber. This sample was to be used to assess the integrity of the sample bottle seals if anomalous data are obtained.

4.3.1.6.2 Equipment Blanks

These samples consist of running 250 ml of de-ionized water through the BFSD2 sampling subsystem prior to deployment. One equipment blank was collected for each site demonstration. The equipment blank was used as a quality control measure to ensure that the BFSD2 was properly decontaminated between deployments.

4.3.1.6.3 Trip Blank

. One trip blank for the San Diego Bay metals demonstration was collected by placing a closed 250-ml sample of de-ionized water in a sample cooler at the beginning of the demonstration. The trip blank was used as a quality control measure, if necessary, to ensure that samples are not contaminated during sample storage and shipment to the laboratory.

4.3.1.6.4 Silica

Confirmatory silica analysis was used for metals tests to ensure that the BFSD2 is functioning properly, without any significant loss of collection chamber seal. Silica is a common component in constructing the hard parts of some planktonic organisms, and it typically fluxes out of sediments at a constant rate due to dissolution processes. By analyzing each of the samples collected using the BFSD for silica and plotting the concentration versus time data, a linear increase in silica concentration over time strongly suggests that there was a good seal of the chamber with the sediment. The first sample at time zero provides a value for silica in bottom waters at the start of the experiment. The silica analysis was performed using 25 ml of seawater removed from each sample collected prior to acid preservation. To maximize sample volume for organics analysis, measured pH data was used to ensure chamber seal integrity.

4.3.1.6.5 BFSD2 System Blanks

Finally, for metals, a triple-duplicate deployment with the collection chamber sealed with a polycarbonate bottom ("blank test") was conducted as an experiment blank at the SSC SD dock in San Diego Bay. The data collected during those deployments provided a baseline with which to compare the site-specific flux rates, in order to document a statistically significant flux rate from both analytical and system variability in a seawater environment. For organics, a triplicate set of blank tests were conducted "*ex-situ*" using a single supply of ambient seawater. The data collected provided less variability due to the constant seawater supply, including sample makeup volumes.

4.3.1.7 Laboratory Blanks

Laboratory Blanks and Laboratory QC checks are designed to assess the precision and accuracy of the analysis, to demonstrate the absence of interferences and contamination from glassware and reagents, and to ensure the comparability of data. Laboratory QC checks consist of laboratory duplicates, surrogates, MS/MSDs, and method blanks. For organics, a Method Detection Limit study was performed to establish modified EPA standard procedures and controls for targeting specific PAHs, PCBs and pesticides with small sample volume. No comparable MDL study was performed for metals because adequate volumes were collected from the chamber for EPA standard procedures in which detection limits were adequate to measure anticipated metals concentrations.

4.3.1.7.1 Method Blanks

Method blanks were used to verify that preparation of samples was contamination-free. Each batch of extracted and digested samples was accompanied by a blank that was analyzed in parallel with the rest of the samples, and carried through the entire preparation and analysis procedure. Method blanks may also be called calibration blanks. Calibration blanks are analyzed for seawater samples analyzed for metals, for seawater samples analyzed for silica, for sediment samples analyzed for metals, and for sediment samples analyzed for SEM.

4.3.1.7.2 Precision

Analytical precision and method detection limits are determined by replicate storage, preparation, and analysis of standard seawater. Further verification of precision is achieved by splitting 1 in 20 field samples. Laboratory duplicates are analyzed during analysis of water samples analyzed for metals, water samples analyzed for alkalinity (if performed), sediment samples analyzed for metals, and sediment samples analyzed for SEM.

4.3.1.7.3 Accuracy

Spiked replicates of field samples were processed with each analytical batch to validate method accuracy within the context of varying matrices. With water and extracted water samples that are analyzed by the method of standard additions, spiked samples are not used. MS and MSD samples were used for analysis of water samples analyzed for metals, sediment samples analyzed for metals, sediment samples for AVS, and sediment samples for SEM.

4.3.1.8 Sample Storage, Packaging, and Shipping

The field team followed chain-of-custody procedures for each sample as it was collected following BFSD2 retrieval. An example chain-of-custody form can be found in Appendix E. The following information was completed on the chain-of-custody form: project number, project name, sampler's name, station number, date, time, station location, number of containers, and analysis parameters.

Following retrieval and removal of the samples from the BFSD at the end of each single deployment, and until shipment to Battelle (metals) or Aurther D. Little (organics), all samples were stored in refrigerators or coolers and maintained with ice at a temperature of approximately 4 $^{\circ}$C. The custody of samples was maintained in accordance with standard operation procedures (SOP). Samples to be shipped to the confirmatory laboratory were packaged and shipped according to the sample packaging and shipment requirements SOP. Copies of these SOPs are available upon request.

4.4 Analytical Procedures

4.4.1 Selection of metals Analytical Laboratory

The analytical laboratory selected to provide analytical services is Battelle Marine Sciences Laboratory (Battelle). Battelle was selected because of its experience with QA procedures, analytical result reporting requirements, and data quality parameters. Battelle is not affiliated with SSC SD or any of the demonstration team members.

4.4.2 Metals Analytical Methods

Sample and data analysis are key elements in the use of samples collected by the BFSD. Samples were analyzed for metals including cadmium, copper, lead, manganese, nickel, and zinc; and silica. The seawater samples collected by the BFSD2 and marine sediment samples were sent to Battelle for analysis. The analytical methods that were used are listed in Table 1. In addition, other metals

including antimony, arsenic, selenium, silver, thallium, and iron, were analyzed in the seawater samples collected during the three blank chamber tests. This data will be used in future projects to establish baseline data for the metals.

Table 1. Analytical Methods.

ANALYTE	SEAWATER SAMPLE	SEDIMENT SAMPLE
	Analytical Method	**Analytical Method**
Cadmium	ICP-MS (Nakashima et al. 1988)	GFAA (Crecelius et al. 1993)
Copper	ICP-MS (Nakashima et al. 1988)	XRF (Crecelius et al. 1993)
Iron	GFAA (Crecelius et al. 1993)	XRF (Crecelius et al. 1993)
Manganese	ICP-MS (Nakashima et al. 1988)	XRF (Crecelius et al. 1993)
Nickel	ICP-MS (Nakashima et al. 1988)	XRF (Crecelius et al. 1993)
Lead	ICP-MS (Nakashima et al. 1988)	XRF (Crecelius et al. 1993)
Zinc	ICP-MS (Nakashima et al. 1988)	XRF (Crecelius et al. 1993)
Miscellaneous Metals - Antimony, Arsenic, Selenium, Silver, and Thallium	ICP-MS (Nakashima et al. 1988) GFAA or XRF (Crecelius et al. 1993)	N/A
Silica(1)	Strickland and Parsons 1968	N/A
Alkalinity	Strickland and Parsons 1968	N/A
Grain Size	N/A	(Plumb 1981)

Total Solids	N/A	(Plumb 1981)
Total Organic Carbon	N/A	(Plumb 1981)
Acid Volatile Sulfide	N/A	(Lasorsa and Casas 1996)
Simultaneously Extracted Metals	N/A	ICP-MS (EPA Method 1638)

N/A – Not Applicable
ICP-MS – Inductively coupled plasma mass spectroscopy
XRF – X-ray florescence
GFAA – Graphite furnace atomic absorbtion\

(1) Silica was analyzed in the field using a HACH DR 2010 instrument to assure sample integrity and to determine whether samples will be sent to the laboratory for full analysis.

4.4.2.1 Preconcentration

The preconcentration method used for this project (Nakashima et al. 1988) was a tetrahydroborate reductive precipitation as a preconcentration technique. Samples were first acidified with nitric acid to pH 1.8 for storage. Samples were then adjusted to pH 8 to 9 with high-purity ammonia solution and iron and palladium were added. A sodium tetrahydroborate solution was added before the solution was filtered through a 25-millimeter (mm) -diameter acid-washed, acid-resistant cellulose nitrate 0.45-micrometer membrane filter. Concentrated nitric and hydrochloric acids are added to the empty bottle to dissolve any precipitate adhering to the walls; the acid mixture was subsequently transferred to the filter assembly. The filter is washed with water, and the solution was diluted to 25 ml. The filter and its holder were rinsed with 3-ml aliquots of the nitric and hydrochloric acids and water between samples, and were used repeatedly. The combination of iron and palladium brought about the rapid formation of a precipitate after the addition of sodium tetrahydroborate.

4.4.2.2 Inductively Coupled Plasma Mass Spectrometry (Nakashima et al. 1988)

ICP-MS analysis allows the simultaneous, multi-elemental determination of metals by measuring the element-emitted light by optical spectrometry. Element-specific atomic-line emission spectra are dispersed by a grating spectrometer, and the intensities of the lines are monitored by photomultiplier tubes.

4.4.2.3 Graphite Furnace Atomic Absorption (Nakashima et al. 1988)

GFAA allows the individual analysis of iron, arsenic, lead, selenium, and thallium to provide lower detection limits. In the furnace, the sample is evaporated to dryness, charred, and atomized. A light beam from a hollow cathode lamp or an electrode-less discharge lamp is directed through the tube into a monochromator and onto a detector that measures the amount of light. Because the wavelength of a light beam is characteristic of a single metal, the light energy absorbed is a measure of that metal's concentration.

4.4.2.4 Silica (Strickland and Parsons 1968)

The sea water sample was allowed to react with molybdate under conditions which result in the formation of the silicomolybdate, phosphomolybdate, and arsenomolybdate complexes. A reducing solution, containing oxalic acid, is then added which reduces the silicomolybdate complex to give a blue reduction compound and simultaneously decomposes any phosphomolybdate or

arsenomolybdate, so that interference from phosphate and arsenate are eliminated. The extinction of the resulting solution was measured using 25centimeter (cm) cells. This method was performed using a Hach Model DR2010 Field Kit prior to sending samples to the laboratory.

4.4.2.5 Sediment Samples

Sediment sample analysis included methods to determine grain size, TOC, AVS and total metals. The collected sediment samples were homogenized and split into subsamples before analysis. Sediment samples for total metals analysis were freeze-dried and ground prior to analysis. Total metals were then determined using X-ray fluorescence (XRF) or GFAA (Crecelius et al. 1993).

4.4.2.5.1 Grain Size (Plumb 1981)

Grain size was measured by a combination of sieving, particle counters, and pipette analysis, as described in the above reference.

4.4.2.5.2 TOC (Plumb 1981)

TOC was measured on an automated carbon analyzer by measuring total carbon and inorganic carbon contents, with the difference providing the TOC values. Inorganic carbon from carbonates and bicarbonates were removed by acid treatment. The organic compounds were decomposed by pyrolysis in the presence of oxygen or air.

4.4.2.5.3 X-ray Fluorescence (Crecelius et al. 1993)

This procedure uses energy dispersive x-ray fluorescence spectroscopy to quantify elemental concentrations in sediment and tissue samples.

4.4.2.5.4 AVS (Lasorsa and Casas 1996)

AVS is operationally defined as the fraction of sulfide present in the sediment that is extracted with cold hydrochloric acid. Analysis of AVS is an indicator of potential metal toxicity in sediments. AVS was determined by photoionization detection (PID) following a step that converted the sulfide in the sample to hydrogen sulfide. During the first step, the sample was allowed to react with 1 N hydrochloric acid, the system was purged with purified inert gas, and produced hydrogen sulfide was trapped using a column immersed in liquid nitrogen. The PID method used gas chromatographic separation and photoionization detection; the area under the curve of the chromatograph was used to calculate sulfide concentration from the linear regression of the standard curve.

4.4.3 Selection of Organics Analytical Laboratory

Arthur D. Little Analytical Laboratory, Cambridge, MA was selected for organics analysis as a result of a successful Method Detection Limit study to optimize detection limits for selected PAHs, PCBs and pesticides form 250 ml seawater samples. The resulting EPA-based procedures and controls were documented and used for all subsequent analyses.

4.4.4 Organics Analytical Methods

See Appendix C for a complete description of the Method Detection Limit study and organic sample analysis procedures and controls.

4.4.5 Data Reduction and Analysis

Correction of concentration for dilution, regression analysis, and flux rate concentrations were calculated using a custom spreadsheet template. See Appendix D for a complete set of spreadsheets for both metals and organics. Results from these complex computations require careful analysis and interpretation to reach valid conclusions. Various other sitespecific data and information must be used in combination with computed flux results to fully interpret the data. The approach taken and the conclusions reached for the demonstrations of this report are presented in the next section.

5. Performance Assessment

5.1 Performance Data

5.1.1 Metals Blank Tests

The primary purpose for performing system blank tests was to establish BFSD2 minimum performance levels, or detection limits, for assessment of flux data obtained during subsequent demonstration tests. Three replicate 70-hour blank tests were conducted using BFSD2 between May 14 and 31, 1998. The tests were conducted from the end of SSC, San Diego Pier 159 at approximately two feet off the bottom in seawater ranging from about 14 to 20 feet deep, depending on tidal flow.

As discussed earlier, the BFSD 2 collection chamber bottom was sealed with a polycarbonate plate and filled with ambient seawater at the start of each 70-hour test. Prior to each test routine procedures for decontamination of the sampling system were performed. Equipment and source blanks were taken. After each test the samples were handled in accordance with EPA Methods 1638 and 1669 and routine chain of custody procedures were used in preparation and shipment to Battelle Marine Sciences Laboratory for analysis. The Silica samples were sent to and analyzed by Scripps Institute of Oceanography.

Each test produced twelve 250ml sample bottles of seawater filtered *in situ* to 0.45 micron. Sample bottle one in each test was filled with ambient seawater taken from the water column as the BFSD 2 was lowered to its test depth at about 15 feet below the surface. Sample bottle two in each test was filled with seawater from the sealed chamber at 6 minutes after start of the 70-hour test. The remaining 10 sample bottles were filled from the chamber at 7-hour intervals. The data, analysis and graphs for each test were processed and compiled in Microsoft Excel spreadsheet, "BFSD2 Blank Tests.xls", provided with the electronic submission of this report. Appendix C provides copies of the spreadsheet results and includes data and graphs for the BFSD2 flow-through sensors. Table 2 below is a summary of the results of the blank tests

Table 2. Metals Blank Test Results Summary.

Metal	Blank Flux ($\mu g/m^2/day$)			Repeatability ($\mu g/m^2/day$)		
	Test 1(12)	Test 2 (6)	Test 3 (6)	Average Flux	+/- 95% C.L.	Std. Deviation
Copper (Cu)	25	-13	15	2.82	8.73	19.7
Cadmium (Cd)	-5.3	-0.8	-0.09	-0.52	0.75	2.8
Lead (Pb)	2.8	5	1	3.16	1.59	2.0
Nickel (Ni)	23	20	-6.7	10.28	7.34	16.4
Manganese (Mn)	-289	-249	-250	-264.85	7.49	22.8
Zinc (Zn)	-194	-13	200	-3.38	-68.61	197
Silica (SiO_2)* (*mg/m2/day)	-4	-3.3	1.4	-1.97	2.88	2.9

5.1.1.1 Discussion of Metals Blank Results

As expected, the blank results for most metals showed little or no time trend, indicating minimal source or loss of target analytes during the blank experiments. Figures 23 through 29 provide graphs of concentration versus time for each analyte for each blank test. With the exception of lead and manganese, replicate analysis indicates that none of the metal fluxes were significantly different from a zero flux condition at the 95% confidence level. Copper results for the three replicates showed both small positive and small negative flux rates. Replicate blanks for cadmium were all small and negative, however the variability was sufficient that the mean was still not significantly different than zero. Results for lead indicated small positive flux rates with a mean value of 2.9 µg/m^2/day which was different from the zero flux condition, suggesting a potential small source of lead in the experimental procedure. Nickel results indicated small positive and negative fluxes with no obvious uptake or sources of nickel from the system. Replicates for manganese all showed substantial negative flux rates indicating a significant loss of manganese due to some aspect of the experimental procedure. Results for zinc showed both positive and negative fluxes with no clear pattern of source or uptake.

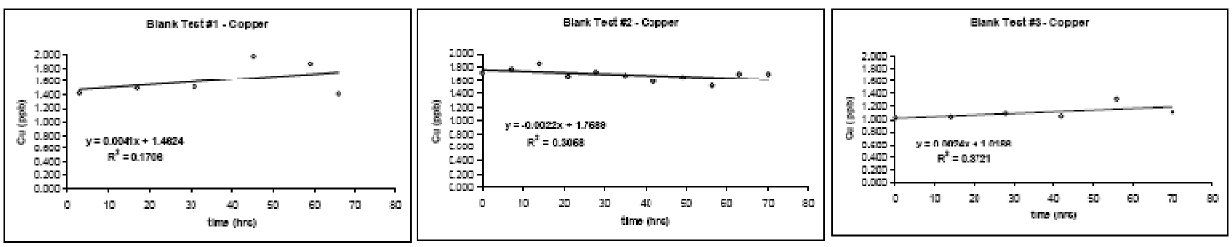


Figure 23. Blank Performance for Copper (Cu**).**

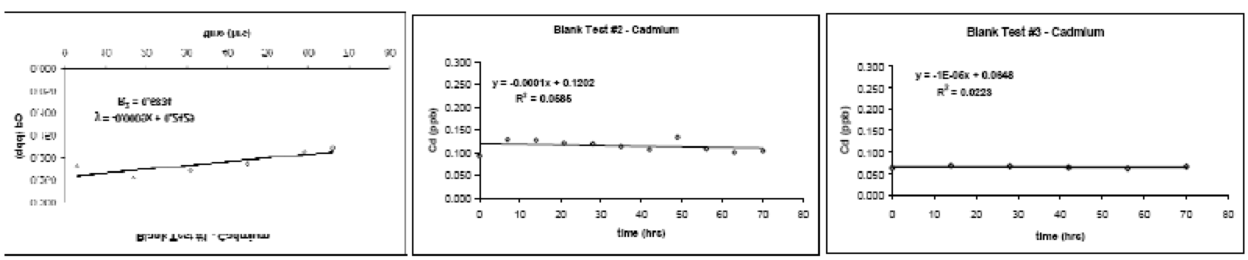


Figure 24. Blank Performance for Cadmium (Cd**).**

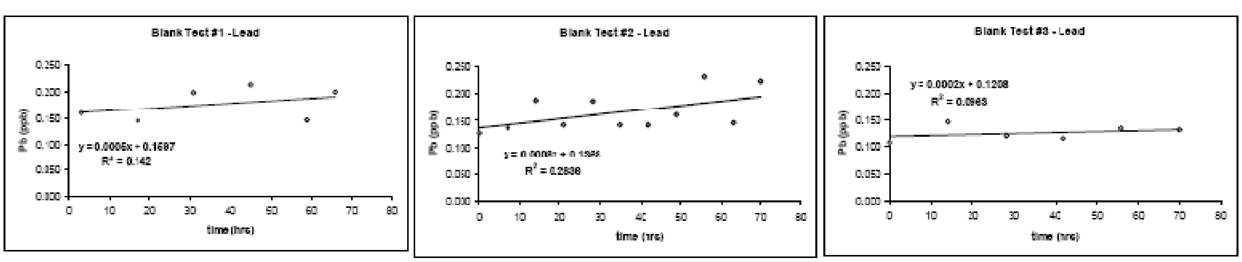


Figure 25. Blank Performance for Lead (Pb**).**

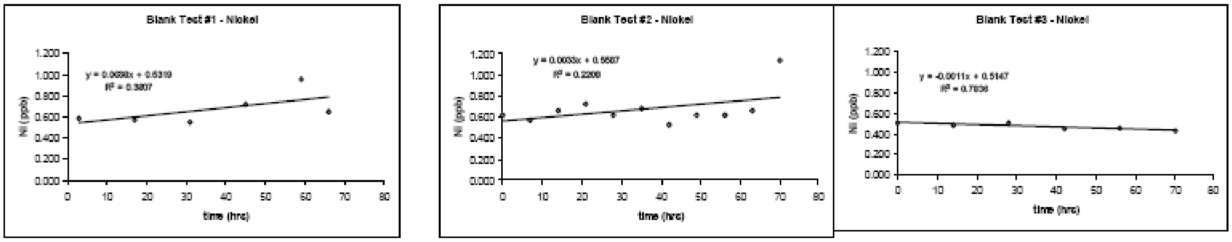


Figure 26. Blank Performance for Nickel (Ni)**.**

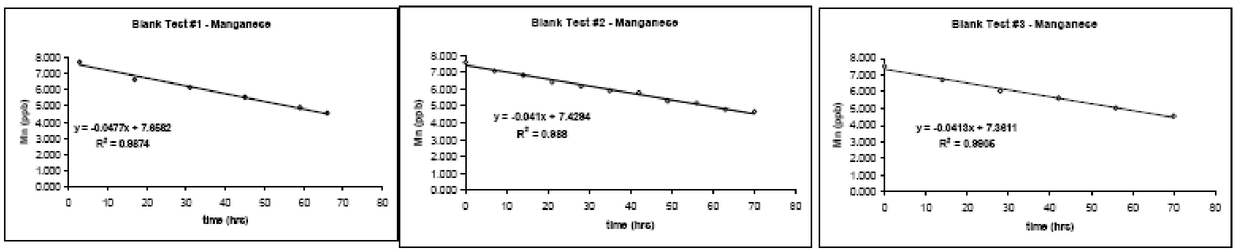


Figure 27. Blank Performance for Manganese (Mn)**.**

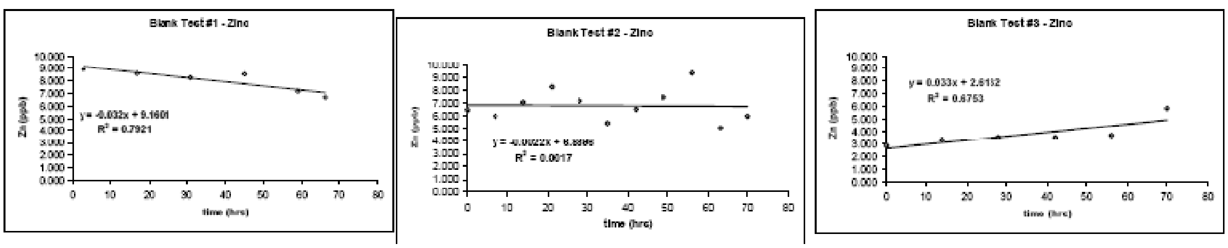


Figure 28. Blank Performance for Zinc (Zn)**.**

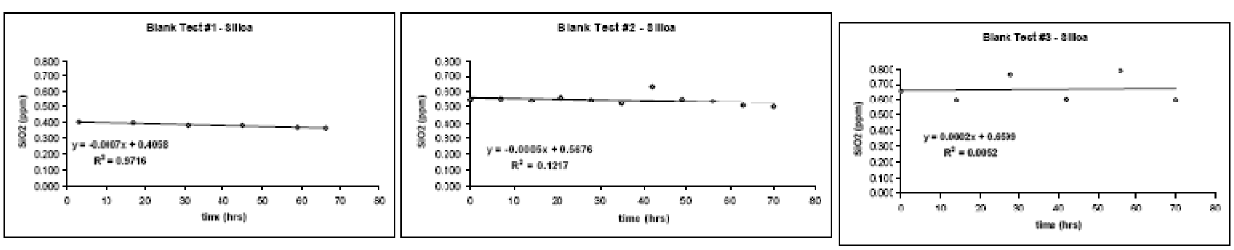


Figure 29. Blank Performance for Silica (Sio_4)**.**

Scripps Institute of Oceanography analyzed silica concentrations, used to indicate chamber integrity and seal. The CA EPA request for an independent analysis of Silica could not be reasonably obtained from Battelle. Subsequent silica analyses were conducted on-site with field analytical systems (i.e., Hach Kit).

Results show a high, very repeatable level of Manganese uptake by the BFSD2. Results from earlier prototype BFSD blank tests were not consistent with this result and further investigation

is warranted. However, because manganese is not generally viewed as a toxic metal, the resolution of this issue is less critical than for other metals.
The somewhat higher blank fluxes observed for zinc are consistent with previous results and are attributed to the ubiquitous nature of zinc and associated contamination during sampling and analysis. Because previously measured flux rates for zinc generally lie outside the range of these blanks, and because of the higher toxicity thresholds for zinc relative to other metals, this is not considered as a serious problem. However, as with all trace metals, care must be taken to minimize zinc contamination during all phases of the experimental procedure. The higher variability between the zinc blank tests will make any results indicating small fluxes of zinc from sediments less conclusive.

5.1.1.2 Discussion of Metals Blank Tests

Although the three blank tests were reasonably trouble free and produced generally high quality data there are a number of points deserving further discussion and explanation.

5.1.1.2.1 Sensors

The flow-through sensors for dissolved oxygen and for pressure, Figures 30 and 31, produced data requiring explanation. The "noisy" dissolved oxygen data was discovered to be due to restricted flow over the sensing element. Flow improvements resolved the problem prior to the Paleta Creek demonstrations (see Figure 35). The oxygen measurements during the blank test are not critical because there is little oxygen depletion when no sediment is present. Drift of the pressure sensor readings was more problematic and resolution required trouble shooting at the factory, after the Paleta Creek demonstrations.

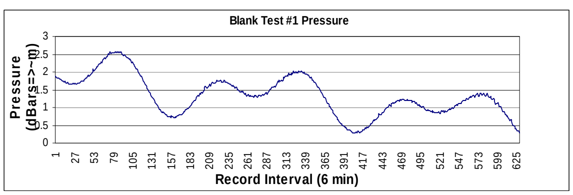


Figure 30. Blank Test Dissolved Oxygen.

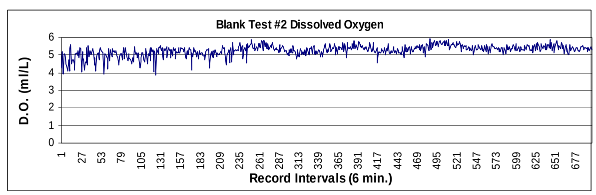


Figure 31. Blank Test Pressure.

5.1.1.2.2 Ambient Seawater Sample

Sample bottle one was not used in blank test analyses, as well as subsequent Paleta Creek demonstration analyses. Analytical laboratory results clearly indicate that the metal concentrations in the water collected in bottle one as the BFSD2 descended to the test depth were not consistent with concentrations in the chamber after it was closed and sealed at the surface prior to descending to the test depth. CA EPA certification evaluators agreed that the sample taken at 6 minutes after the start of the test was a better representation of replacement water entering the chamber. The unused concentration value is still shown, in bold, in the spreadsheet. A sensitivity analysis of the affect of this change on dilution correction calculations and subsequent flux results show it to be insignificant. Consequently, an improved method to fill sample bottle one from more representative bottom water was implemented.

5.1.1.2.3 Metals Sample Analysis

Not all samples were analyzed to minimize analytical costs. For Blank Test 1 only the six odd-numbered samples were analyzed (with further changes, see next paragraph); for Blank Test 2 all

twelve samples were analyzed; for Blank Test 3 only the six even-numbered samples were analyzed. Also, additional trace metals beyond those identified for CA EPA certification evaluation were analyzed for future applications.

Blank Test 1 suffered a "False Start" when an error in a software control loop shut the test down after six minutes, following sample bottle two filling. The error was corrected from the surface and the test was restarted three hours later without raising the BFSD2 from the test depth. Sample bottle three filled immediately upon restart and sample bottle two was retained as representative of ambient conditions. To complete the set of six samples, sample bottle twelve with a 7-hour interval was added to the other odd-numbered samples. Blank Test 1 was 66 hours total duration.

5.1.1.3 Metals Blank Tests Assessment

It was concluded that the BFSD2 metals blank performance was statistically established and the values obtained were repeatable, precise and accurate enough to allow valid measurement of *in situ* sediment flux rates.

5.1.2 Organics Blank Tests

Three replicate 70-hour blank tests were conducted using BFSD2 between September 1, 2000 and November 27, 2000. The purpose of the tests was to establish system performance levels for selected polynuclear aromatic hydrocarbons (PAH) using standardized procedures as part of the demonstration project. Performance levels for selected polychlorinated biphenyl (PCB) congeners and pesticides were also measured for future potential applications. As shown in Figure 32, the tests were conducted *ex situ* at SSC San Diego using Naval Station San Diego (Paleta Creek) seawater.

Figure 32. *Ex Situ* BFSD2 Organics Blank Test Physical Setup.

The BFSD 2 collection chamber bottom was sealed with a polycarbonate plate and filled with seawater collected from the Paleta Creek industrial area within Naval Station San Diego, at the start of each 70-hour test. Paleta Creek has been designated as a "toxic hotspot" by the Regional Water Quality Control Board and has been selected for the initial demonstration of BFSD 2 for organics applications. Makeup seawater to replace collected sample volume and any leakage was likewise the same Paleta Creek source seawater. Prior to each test, routine procedures for decontamination of the sampling system were performed. The procedure differed from that used in metals applications only in that the Nitric acid rinse was omitted and a final Methanol rinse

was added. Samples were collected into 250ml precleaned amber glass sample bottles fitted with custom inline filter assemblies (Figure 6b). The filter element was a 47mm Gelman 1.0-micron binder-less borosilicate glass filter prepared by pre-combustion for 24 hours at 375 degrees Fahrenheit. The samples were collected, capped, labeled and shipped in the same commercially standard sample bottle. Routine chain of custody procedures were used for overnight shipment to Arthur D. Little, Inc. (ADL) analytical laboratory in Cambridge, MA. All samples were collected, shipped (chilled to 4 degrees), received and extracted within the EPA seven-day hold time requirement. Laboratory processing and analysis of the samples was in accordance with EPA SW-846 methods and procedures, including Methods 8270M and 8081A protocols modified based on results from a Method Detection Limit study performed under contract N66001-96-D-0050 by ADL for this project.

Each test produced twelve filtered 250ml (approximately) samples and one additional 500ml unfiltered source sample. Sample bottle one in each test was filled with source seawater passed through the chamber lid closure-activated valve at the initiation of the 70- hour test. Sample bottle two in each test was filled with seawater from the sealed chamber approximately 6 minutes after chamber lid closure. The remaining 10 sample bottles were filled from the sealed chamber at 7-hour intervals. The 500ml unfiltered sample was taken from the residual source seawater container at the conclusion of the test. Table 3, 4 and 5 are summaries of the results of the organics blank tests.

Table 3. PAH Blank Tests Results Summary.

PAH	Blank Flux (ng/m^2/day)			Repeatability (ng/m^2/day)		
	Test 1	Test 2	Test 3	Average Flux	+/- 95% C.L.	Std. Deviation
1. Naphthalene	-243.5	-448.1	-629.3	-440	218.4	193.0
2. Acenaphthene	-32.4	ND	ND	-32.4	n/a	n/a
3. Acenaphthylene	-350.2	141.0	275.9	22.2	372.9	329.5
4. Fluorene	125.5	-69.3	-84.2	-9	132.4	117.0
5. Phenanthrene	89.0	-39.8	-16.3	11	77.6	68.6
6. Anthracene	182.3	53.1	-324.8	-30	298	263
7. Fluoranthene	-421.5	-1539.0	-1308.9	-1089.8	667.8	590.1
8. Pyrene	76.6	-447.1	-431.9	-267.5	337.3	298.0
9. Benzo(a)anthracene	ND	ND	ND	n/a	n/a	n/a
10. Chrysene	23.9	-61.9	ND	-19.0	84.2	60.7
11. Benzo(b)fluoranthene	ND	ND	-134.3	-134.3	n/a	n/a
12. Benzo(k)fluoranthene	ND	ND	-9.8	-9.8	n/a	n/a
13. Benzo(a)pyrene	ND	ND	ND	n/a	n/a	n/a
14.Indeno(1,2,3-c,d)pyrene	ND	ND	ND	n/a	n/a	n/a
15. Dibenz(a,h)anthracene	ND	ND	ND	n/a	n/a	n/a
16. Benzo(g,h,I)perylene	ND	19.6	ND	19.6	n/a	n/a

Table 4. PCB Blank Test Results Summary.

PCB	Blank Flux (ng/m^2/day)			Repeatability (ng/m^2/day)		
	Test 1	Test 2	Test 3	Average Flux	+/- 95% C.L.	Std. Deviation
(8) 2,4'-Dichlorobiphenyl	-66.6	ND	47.8	-9.4	112.2	80.9
(18) 2,2',5-Trichlorobiphenyl	205.2	23.3	27.0	85.2	117.6	104.0
(28) 2,4,4'-Trichlorobiphenyl	-8.0	ND	ND	-8.0	n/a	n/a
(52) 2,2',5,5'-Tetrachlorobiphenyl	ND	7.9	89.9	49	80.4	58.0
(66) 2,3',4,4'-Tetrachlorobiphenyl	53.6	16.6	ND	35	36.2	26.2
(101) 2,2',4,5,5'-Pentachlorobiphenyl	57.8	57.4	-3.5	37	40	35
(118) 2,3',4,4',5-Pentachlorobiphenyl	ND	2.7	2.3	2.5	0.3	0.2
(153) 2,2',4,4',5,5'-Hexachlorobiphenyl	ND	ND	9.5	9.5	n/a	n/a
(180) 2,2',3,4,4',5,5'-Heptachlorobiphenyl	ND	-9.6	ND	-9.6	n/a	n/a
(206) 2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl	-2.8	247.0	-17.0	75.7	168.0	148.5
(209) 2,2',3,3',4,4',5,5',6,6'-Decachlorobiphenyl	-18.5	ND	ND	-18.5	n/a	n/a

Table 5. Pesticide Blank Test Results Summary.

Pesticide	Blank Flux (ng/m^2/day)			Repeatability (ng/m^2/day)		
	Test 1	Test 2	Test 3	Average Flux	+/- 95% C.L.	Std. Deviation
alpha-Chlordane	7.0	ND	ND	7.0	n/a	n/a
2,4'-DDD	7.0	ND	ND	7.0	n/a	n/a
Methoxychlor	25.7	ND	ND	25.7	n/a	n/a
Endosulfan I	48.8	ND	ND	48.8	n/a	n/a
hexachlorobutadiene	ND	ND	22.0	22.0	n/a	n/a
Heptachlor	304.5	ND	ND	304.5	n/a	n/a
Heptachlor Epoxide	ND	ND	8.8	8.8	n/a	n/a
alpha-hexachlorocyclohexane	3.3	ND	ND	3.3	n/a	n/a
beta-hexachlorocyclohexane	61.0	ND	ND	61.0	n/a	n/a
lindane	35.2	132.3	33.8	67.1	63.9	56.5
trans-Nonachlor	40.8	ND	ND	40.8	n/a	n/a

5.1.2.1 Results of Organics Blank Tests

The Paleta Creek seawater collected for these tests contained a broad mixture of dissolved organic contaminants targeted by this study, but not all 63 of them. Of the 34 targeted organic contaminants that were detected, a number of them were not measurable in all three blank tests. Further, within a number of individual blank tests where a target contaminant was detected, one or more time-series samples fell below the detection limits. Notwithstanding such issues, analysis results plotted as time-series, with non-detects removed, show little if any, release or uptake of detected target contaminants by the BFSD2 with the exception of Naphthalene and Flouranthene. These two PAHs both consistently indicated an uptake trend likely due to sorption onto the many plastic surfaces of the collection chamber and recirculation system. Statistical analysis of the data for repeatability was applied to those tests with multiple measurements.

For the targeted EPA 16 Priority PAHs, the results were generally complete for the eight lowest molecular weight (through three Benzene rings) compounds. “Non detects” were much more prevalent with the eight heavier molecular weight PAHs (four-ring including Benzo(a)anthracene and higher) and four of the 16 targeted PAHs were not detected in all three blank tests although source seawater did indicate very low concentrations (less than 2 ng/L or parts/trillion) were present. Acenaphthene, a two-ring PAH, was the only low molecular weight compound not sufficiently detected in all three blank tests to establish repeatability statistics however a time-series flux trend (uptake or release) was established. Acenaphthene was detected in all three seawater source samples and in all 12 blank test 1 samples but dropped below detection limits in 10 of 12 blank test 2 samples and 9 of 12 blank test 3 samples. All remaining light-end PAHs (up to Pyrene) were detected in all 12 samples of all three blank tests and Table 3 provides full repeatability statistics for them. Time-series flux trends were also established for all of them. None of the heavier-end PAHs were detected sufficiently in all 12 samples of all three blank tests to yield full repeatability statistical results. Only Chrysene was detected sufficiently in two of the three blank tests to establish limited repeatability statistics. Benzo(b)fluoranthene, Benzo(k)fluoranthene and Benzo(g,h,I)perylene were detected sufficiently in only one blank test and repeatability statistics cannot be developed for them. Time-series flux trends were established for all four of these heavier-end PAHs. The remaining four PAHs (Benzo(a)anthracene, Benzo(a)pyrene, Indeno(1,2,3c,d)pyrene and Dibenz(a,h)anthracene) were not sufficiently detected in any of three blank tests to establish either repeatability statistics or time-series trends.

For the 20 targeted PCB congeners and 16 targeted pesticides, the results were somewhat less complete. Three PCB congeners (#18, #101, #206) and one pesticide (Lindane) were sufficiently detected in all three blank tests to establish full repeatability statistics and time-series flux trends. Two of the 20 PCBs and one of the 16 pesticides were detected sufficiently in two of the three blank tests to establish limited repeatability statistics and time-series flux trends. Four of 20 targeted PCBs and nine of the 16 targeted pesticides were detected in only one blank test with sufficient data to establish time-series flux trends, but not repeatability statistics. The remaining eleven PCB congeners and five pesticides were not detected sufficiently in any of the three blank tests to establish either repeatability statistics or time-series trends. Six of these remaining eleven PCB congeners and all five of these remaining pesticides were not detected in the unfiltered source seawater.

5.1.2.2 Discussion of Organics Blank Tests

It was not unexpected to find very low levels of the heavier PAHs dissolved in the source seawater because of the known reduction in solubility of PAHs as the number of Benzene rings increase. This insolubility, combined with a low, but limited detection limit led to less complete and even non-detection of the heavier PAHs. However, the number of Benzene rings common within groupings of

PAHs allows a limited extension of the otherwise generally complete results. This applies for groupings of two and three-ring contaminants as well as the less complete and even missing results within the four, five and six-ring contaminant groupings. Within groups, time-series results for missing PAHs can be predicted to be consistent with those that were measured. This prediction can be made for both the complete lighter PAH results and the less complete heavier PAH results. Overall, the results establish that the various plastic and other materials of the BFSD2 which are in contact with the sampled seawater do not adversely adsorb or release the target PAHs within measurable limits, with the possible exceptions of Naphthalene and Flouranthene, as described in the Results section. Apparent adsorption of these two PAHs introduces a relatively small error to field measurements which are subsequently resolved by normalization during data processing. Furthermore, careful consideration was made when materials for the chamber, mixing mechanism and sample bottles were considered. Surfaces for minimal adsorption or release of the entire suite of contaminants analyzed were considered and practical decisions made. With polycarbonate chamber, Teflon flow lines and valves and glass sample bottles, the BFSDII has the most practical combination of materials for the minimal adsorption of release of these contaminants. Finally, although repeatability statistics requires more than a single data set, and three tests were conducted, those contaminants with only two data sets were analyzed albeit with lower confidence results. The repeatability of PAHs with a single data set can only be estimated, with no statistical confidence, and the four heavier PAHs with no data sets can only be predicted, as above. Thus, because of the common attributes of groups of PAHs and with the established results where data were available, it is estimated and predicted that field measurements of those PAHs with incomplete blank test results will be approximately similar to the other more complete PAHs measured. At sites where precise measurements are required for targeted PAHs which were not established with this series of blank tests an additional blank test using site-specific seawater or clean seawter or clean seawter spiked with the target PAH(s) may be necessary

Common features among PCB congeners allow much the same degree of extension of results discussed above for PAHs. Pesticides do not however support the same degree of extension because of the uncertainty of their composition and the limited results achieved. Pesticides were detected at much lower concentrations than the PAHs. For both PCBs and pesticides, blank test data sets that were sufficiently complete did establish acceptable repeatability considering such low levels (<1 ng/L). The remaining blank tests (with only one data set) established, as with PAHs, that the various plastic and other materials of the BFSD2 which are in contact with the sampled seawater do not adsorb or release the particular PCB congener or pesticide within measurable limits. The time-series flux trends for these contaminants show low and variable rates (slopes). It is noted that PCB congener 18 (2,2',5-Trichlorobiphenyl) showed a small release during the first blank test, but did not repeat in subsequent tests. In order to make the most from the available data, especially where only one of the three blank tests had sufficient detects (i.e., at least 6 measurements distributed evenly or grouped at one end), non-detects were removed and the remaining measurements used. This approach was used extensively for the PCB congeners and pesticides and much less for the heavier PAHs (only).

Ancillary data collected and recorded, including chamber temperature, pressure, salinity, pH and dissolved oxygen indicated chamber conditions remained stable throughout the tests. The pH sensor recorded a slight reduction in pH (<0.5) which occurred gradually over 70 hours in all three tests. The pressure sensor recorded changes in barometric conditions as well as the vacuum affect of each sample collection bottle being activated at 7-hour intervals during the tests.
Silica measurements used to confirm chamber integrity during BFSD2 metals applications will not be used for organics applications. The need to conserve sample volume to maximize detection levels

combined with experience in comparing onboard sensors with silica results in previous tests supports reliance on the sensors to identify any loss of chamber seal integrity. Dissolved oxygen an pH followed distinct trends when the silica test indicated a good seal. These two parameters show promise in interpreting seal integrity and will be used during organics applications.

5.1.2.3 Organics Blank Tests Assessment

It was concluded that the BFSD2 organics blank performance was adequately established and the values obtained are sufficiently repeatable, precise and accurate to statistically distinguish differences from measured *in situ* sediment flux rates for a number of targeted PAHs. Measurement of *in situ* flux rates for selected PCB congeners and pesticides are also statistically distinguishable where blank test results are available.

5.1.3 San Diego Bay, Paleta Creek Metals Demonstrations

Two 70-hour metals demonstrations of BFSD 2 were conducted at the heavily industrialized Paleta Creek entrance to San Diego Bay (see Figure 33). The quiescent, marina-like area is used for mooring support craft and receives periodic stormwater inflow from the Paleta Creek drainage basin. The site was selected due to known levels of trace metals in the sediments, as established in two previous prototype BFSD tests, and because of its convenient location for an initial field test and first demonstration of BFSD2. Two demonstrations were conducted two weeks apart (June 6-8, 1998 and June 18-22, 1998) with the first demonstration being a full dress rehearsal for the second, formal demonstration. The locations for the tests were within 10 feet of one another and within the same proximity to two previous prototype BFSD deployments. The tests were conducted at about 18 +/- 3 feet depth, depending on tidal flow, and offshore about 30 feet from a quay wall. Deployment and retrieval was from the SSC SD research vessel R/V ECOS.

Figure 33. BFSD2 Paleta Creek Metals Deployment.

Prior to both tests, the BFSD 2 was cleaned and prepared using the same procedures used during the triplicate blank tests. Aboard R/V ECOS after loading and connecting various equipment (laptop computer, TV monitor and light, cabling) a standard pre-deployment checklist was followed. Once moored at the site with the GPS location logged, the BFSD 2 was lowered to within 2 feet of the bottom and a 15-minute test was started to stabilize the flow-through sensors and to measure the ambient dissolved oxygen level. This test was run twice during the first demonstration to assure repeatability. The ambient dissolved oxygen level is used to establish system control limits for maintaining a narrow range of dissolved oxygen in the collection chamber during the 70-hour test and for assessment of sediment oxygen uptake rates. As requested by CA EPA certification

evaluators, a second, independent dissolved oxygen measurement was made outside the collection chamber during the second demonstration by attaching an additional instrument to the BFSD 2 frame next to the collection chamber.

After entering the control limits into the 70-hour test program software and downloading it, the BFSD2 was raised for manual activation of the number one sample bottle valve. A new, higher mounting location for the valve was implemented following the blank tests to improve collection of representative ambient bottom water. With the BFSD2 partially submerged and the collection chamber approximately 3 feet below the surface, the valve was opened manually and the BFSD2 was immediately lowered back to approximately 2 feet from the bottom. After a short delay to arrange deck release lines, the BFSD2 was then allowed to free-fall to the bottom and insert its collection chamber into the sediment.

The landing and insertion were monitored using a video camera. Activation of the three insertion indicator lights was verified. The video camera, aided by a floodlight, also allowed a limited assessment of the site prior to initiating the 70-hour test. And, after starting the test, it also allowed confirmation of lid closure prior to complete detachment of lanyards and connections for autonomous operation. Both demonstration deployments were straightforward and without problems. The R/V ECOS returned to SSC SD and left the BFSD2 in its autonomous operation mode.

Retrieval of the BFSD2 after the tests was routine except for malfunction of the commercial acoustic recovery system. Recovery was with a separate line stowed at the site. Acoustic receiver burn-wire modification, latch modification, and most importantly, sandpaper cleaning of the ground electrode were subsequently implemented. Once BFSD2 was washed down and on deck, the twelve 250ml sample bottles were removed for processing using EPA handling and chain of custody procedures. During the first demonstration the samples were returned to SSC SD for splits (silica and metals). For the second demonstration splits were made aboard R/V ECOS using pre-acidified 125ml containers for metals samples and pre-cleaned 25ml beakers for silica measurements. Silica measurements were made aboard R/V ECOS using a field portable Hach model DR2010 Instrument. The metals samples were packaged and shipped to Battelle Marine Sciences Laboratory for analysis of the six metals selected for CA EPA certification evaluation. All data and results for the two demonstrations are compiled in Microsoft Excel spreadsheets “BFSD2 PCPD.xls” and “BFSD2 PCD.xls”, provided with the electronic submission of this report. Appendix C provides copies of the spreadsheet results and includes data and graphs for the BFSD2 flow-through sensors.

Tables 6 and 7 summarize the results of the two Paleta Creek metals demonstrations.

Table 6. BFSD 2 Metals Results from the Paleta Creek Pre-Demonstration (PCPD**).**

Metal	Flux ($\mu g/m^2/day$)	+/- 95% C.L. ($\mu g/m^2/day$)	Flux rate Confidence (%)	Triplicate Blank Flux ($\mu g/m^2/day$) Average	Triplicate Blank Flux +/- 95% C.L.	Bulk Sediment ($\mu g/g$)	Overlying Water ($\mu g/L$)
Copper (Cu)	-1.75	19.71	38.1%	2.82	8.73	165	1.54
Cadmium (Cd)	9.64	4.14	100.0%	-0.52	0.75	1.16	0.148
Lead (Pb)	11.06	7.94	100.0%	3.16	1.59	98.9	0.1561
Nickel (Ni)	25.24	4.62	100.0%	10.28	7.34	19.1	0.9262
Manganese (Mn)	71.33	701.54	80.7%	-264.85	7.49	405	28.12
Manganese (Mn)[1]	5763.99	23621.74	100.0%	-264.85	7.49	405	28.12
Zinc (Zn)	715.02	257.38	100.0%	-3.38	65.22	356	8.90
Other							
Oxygen (O_2)* (*ml/m²/day)	-1050.87	86.25	na	na	na	na	5.2
Silica (SiO_2)* (*mg/m²/day)	30.29	11.33	100%	-1.97	2.88	na	0.81

1. Mn flux calculated on the basis of first three samples due to non-linearity

Table 7. BFSD 2 Metals Results from the Paleta Creek Demonstration (PCD**).**

Metal	Flux ($\mu g/m^2/day$)	+/- 95% C.L. ($\mu g/m^2/day$)	Flux rate Confidence (%)	Triplicate Blank Flux ($\mu g/m^2/day$) Average	Triplicate Blank Flux +/- 95% C.L.	Bulk Sediment ($\mu g/g$)	Overlying Water ($\mu g/L$)
Copper (Cu)	-6.57	17.74	80.7%	2.82	8.73	165	1.46
Cadmium (Cd)	7.02	3.87	100.0%	-0.52	0.75	1.16	0.06897
Lead (Pb)	4.32	12.39	65.6%	3.16	1.59	98.9	0.07879
Nickel (Ni)	19.44	8.75	99.8%	10.28	7.34	19.1	0.8378
Manganese (Mn)	103.94	957.14	73.3%	-264.85	7.49	405	24.02
Manganese (Mn)[1]	4194.24	101841.32	99.9%	-264.85	7.49	405	24.02
Zinc (Zn)	574.26	274.14	100%	-3.38	-68.61	356	8.38
Other							
Oxygen (O_2)* (*ml/m²/day)	-1341.12	160.18	na	na	na	na	4.7
Silica (SiO_2)* (*mg/m²/day)	28.75	15.63	100%	-1.97	2.88	na	0.79

1. Mn flux calculated on the basis of first three samples due to non-linearity

Numbers in the Flux Rate Confidence column indicate the statistical confidence that the measured flux rate is different than the blank flux rate. Results from the blank study, bulk sediment analysis, overlying water and oxygen uptake analysis are shown for comparison.

Figures 34 and 35 illustrate graphical comparison of the results.

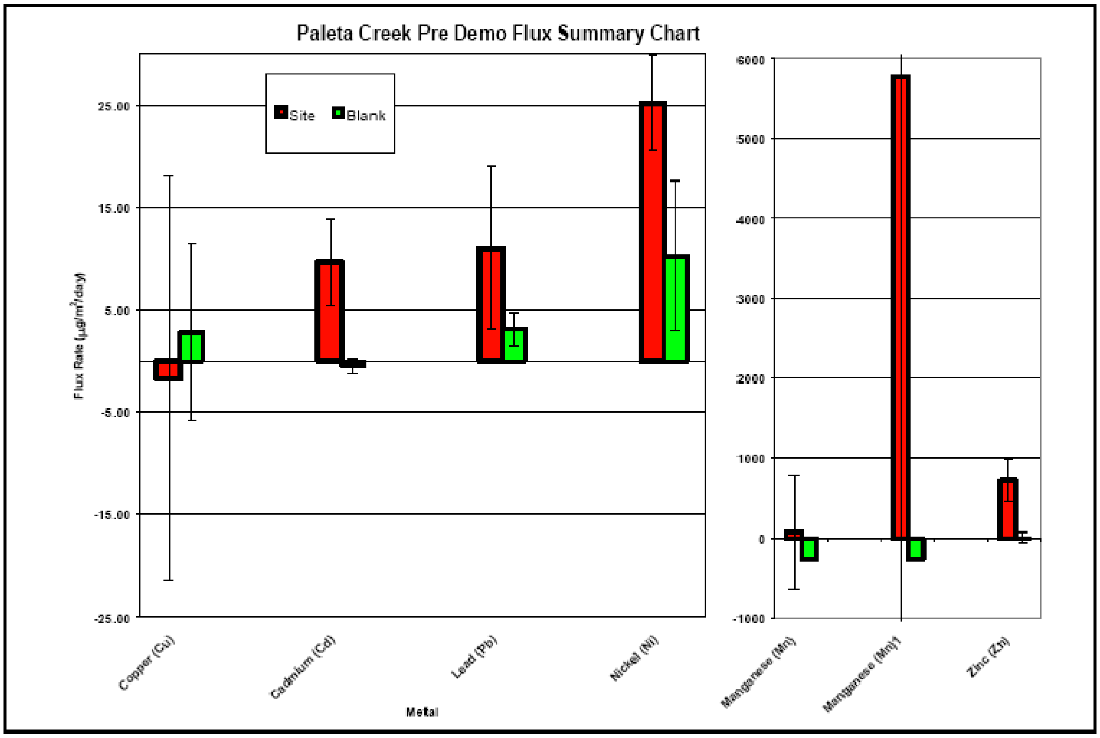


Figure 34. Paleta Creek Metals Pre-Demonstration Results.

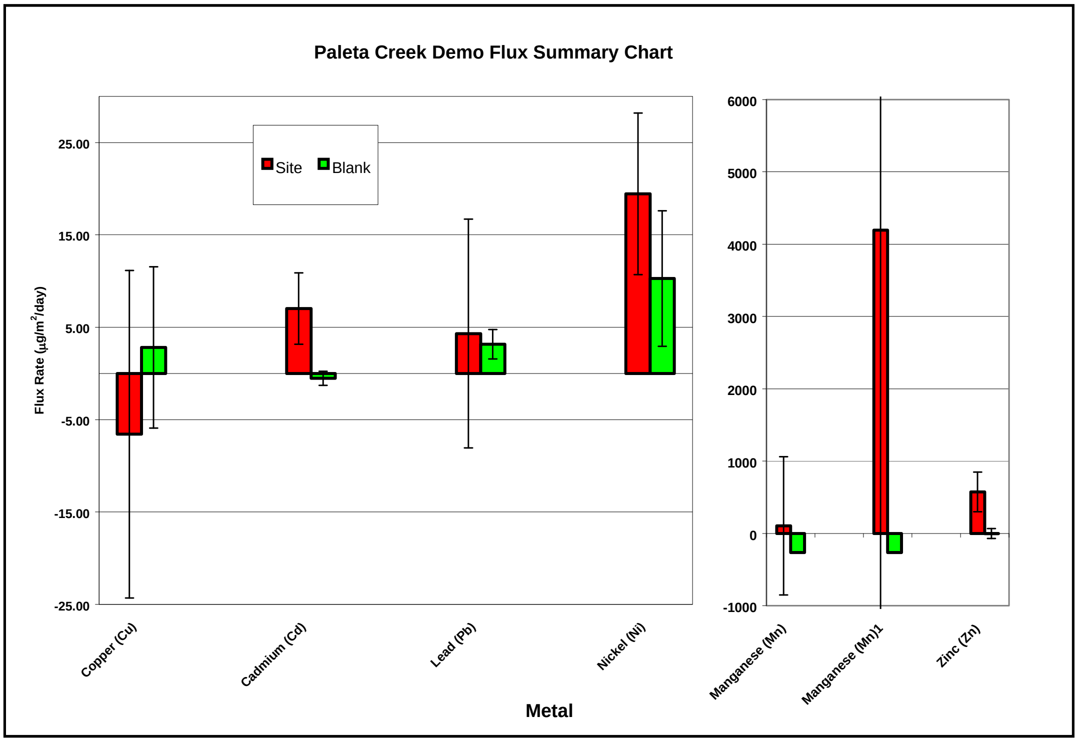


Figure 35. Paleta Creek Metals Demonstration Results.

5.1.3.1 Discussion of Paleta Creek Demonstrations Results

In general, BFSD2 results from the two Paleta Creek demonstrations were similar and consistent with previous prototype deployments at this location. Figures 36 and 37 are the sets of graphs of concentration versus time for each analyte (red squares) in each of the demonstrations, compared with blank performance (blue triangles). The concentrations of analyte plotted on these graphs here and throughout this report are not the measured concentrations of each sample but concentrations that have been corrected for dilution effects from sampling water from the chamber and intercept corrected for the linear slope analysis. Therefore the concentrations shown could change depending on how many samples are included in the slope analysis. This is illustrated well in the manganese graphs where two slope analyses were performed with different numbers of samples. It appears concentrations for each sample are different. These graphs were generated in the process of calculation the slope or flux of each analyte, and it is the flux rate and not individual sample concentrations which are interpreted in these graphs.

The results for the Pre-Demonstration indicate that Cadmium, Lead, Nickel and Zinc had fluxes out of the sediment that were highly significant when compared to the blank chamber results. The flux of copper indicated a negative flux (sediment uptake) although the statistical confidence was only 65%.

Manganese fluxes showed a consistent trend or pattern here at Paleta as well as at subsequent deployments in Pearl Harbor. Flux curves would define a higher rate of flux in the first part of the test while becoming lower or negative in the later part. The reason for this drop is not known, but could be attributed to oxidation and subsequent precipitation or flocculation when the chamber water reached a high concentration which results in a “quenching”-like trend. Certainly some process was changing the flux rate of manganese as the test proceeded. So, in order to estimate actual flux rates of manganese from sediments as if the chamber were not present, the first three values obtained from the test was used for calculating a flux rate. This is similar to how dissolved oxygen demand is calculated before the system becomes anoxic and/or the oxygen feed system kicks in. This approach results in a more conservative estimate of flux rates for this metal, i.e. higher outward fluxes. We will use and discuss the flux values obtained from this later method of using the first three samples drawn from the chamber for manganese. However, flux curves and values from estimated from the entire test duration are also presented here for consideration. Therefore, manganese also had a positive outward flux as did cadmium, lead, nickel and zinc but the statistical confidence was somewhat lower.

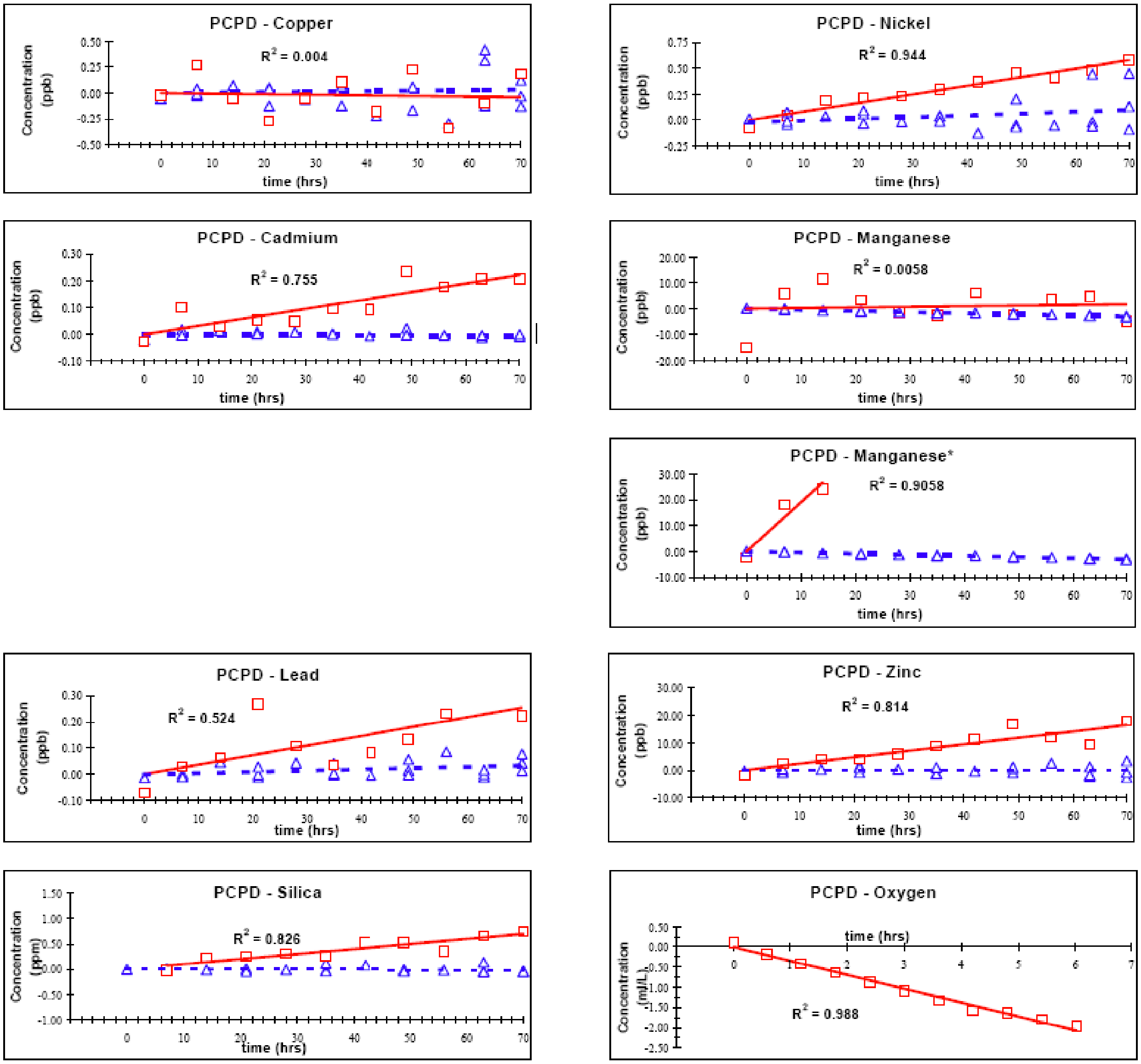


Figure 36. Paleta Creek Metals Pre-Demonstration Concentration vs. Time.

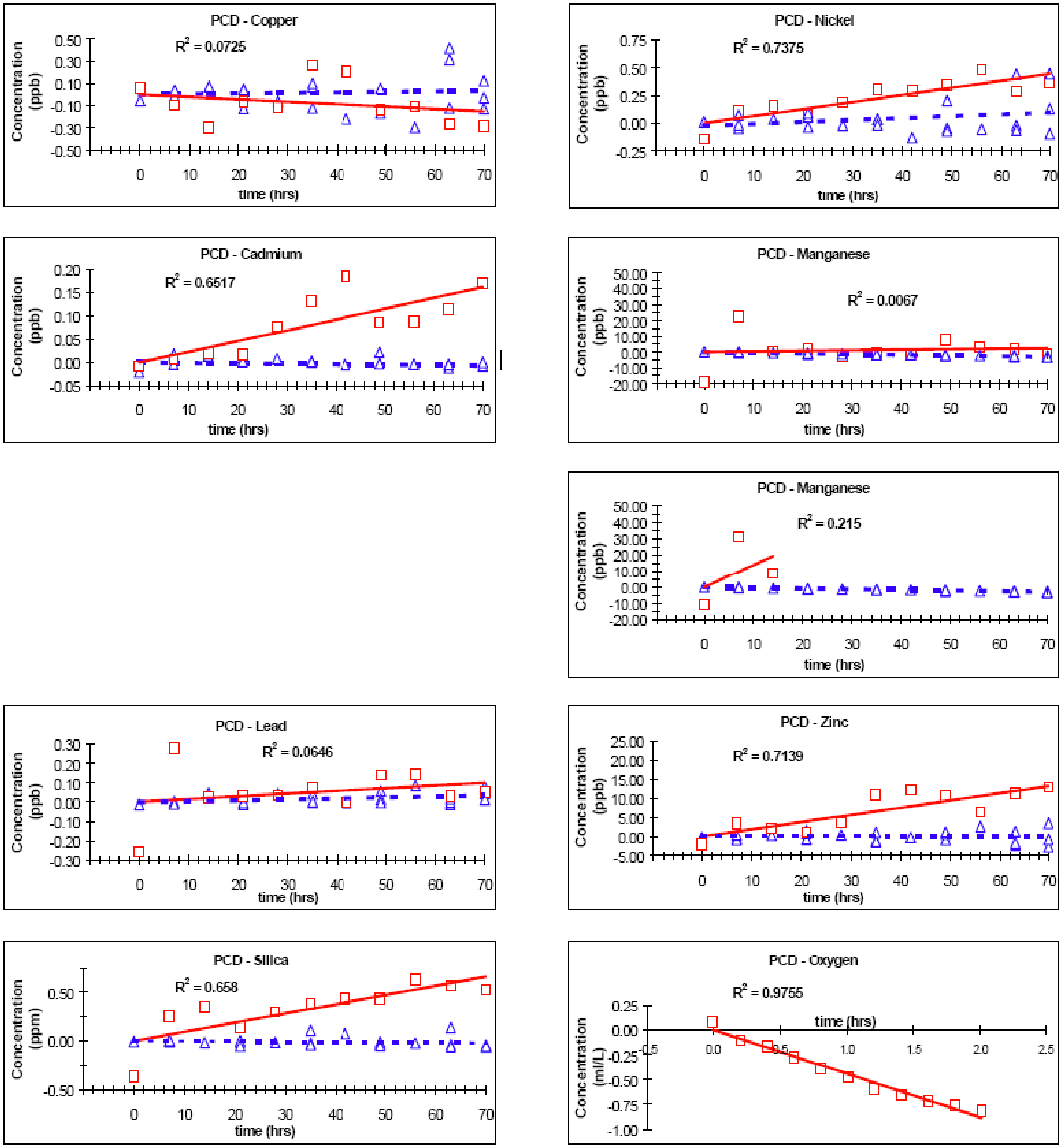


Figure 37. Paleta Creek Metals Demonstration Concentration vs. Time.

Results for the formal Demonstration were similar to those of the Pre-Demonstration with the exception of Lead. Cadmium, Nickel and Zinc all had fluxes out of the sediment that were highly significant when compared to the blank results. The magnitude of the Cadmium, Nickel and Zinc fluxes for the Demo were similar, though slightly lower, than those observed for the Pre-Demonstration. Manganese again had a positive outward flux but a lower statistical confidence. As with the Pre-Demonstration, the flux of copper was negative (sediment uptake) although the statistical confidence was <0.1%.

5.1.3.1.1 Flux Measurements

As shown in Tables 6 and 7, and illustrated in Figures 34 through 37, cadmium, lead, nickel, manganese and zinc all had positive flux rates which were statistically different from blank test results. Also, the relative magnitudes of the flux rates were consistent for both demonstrations and with earlier prototype work at the site. In other words, zinc had a larger flux rate than manganese; manganese was larger than nickel; nickel was larger than lead; lead and cadmium were very close to the same magnitude. The magnitude of the flux rates for the formal Demonstration were generally similar, though somewhat less (except manganese), than those of the Pre-Demonstration test two weeks earlier, however, the differences are not statistically significant. A correlation with sediment oxygen uptake is evident and may be an explanation for the slight downward shift of fluxes. The flux rate for manganese is likely more positive than measured when corrected by the large, very repeatable negative flux measured in the blank tests. Copper results indicate a slightly negative flux (sediment uptake) which has been observed in previous work. This may be attributed to pore water chemistry involving sulfide binding, complexation with organic matter, or elevated water column concentrations associated with hull leachate sources as discussed extensively in earlier reports. The oxygen uptake measured during both deployments is consistent and indicates continuous consumption of dissolved oxygen, which can be attributed to oxidation of organic matter and biological uptake at the sediment water interface.

5.1.3.2 Discussion of Paleta Creek Demonstrations Tests

Important aspects of the demonstrations including performance indicators and deployment problems are discussed below.

5.1.3.2.1 Performance Indicators

Several methods were used to evaluate system performance of the BFSD2 during and after the demonstrations. To assure a proper seal of the chamber, the deployment was monitored with an underwater video camera, insertion light indicators connected to pressure sensors on the sealing flange were monitored, and silica, pH, and oxygen levels within the chamber were monitored for expected trends. Landing and insertion monitored with the video camera and landing lights indicated a good seal. After starting the test, the video camera also confirmed lid closure of the chamber.

A linear increase in silica during the deployments was used as another indicator of proper system performance and chamber seal. The results, shown on Figures 36 and 37, show that silica concentration increased linearly, and that the silica flux rates were consistent and repeatable for the two deployments, indicating proper system performance and chamber seal. Oxygen variations in the chamber were monitored to assure maintenance of ambient oxygen levels, proper chamber seal, and to evaluate sediment oxygen uptake. The rate of oxygen consumption (sediment uptake) during the deployments, also shown in

Figures 36 and 37, was sufficient to cause repeated cycling of the BFSD2 oxygen recharge subsystem. Figure 38 are graphs of the oxygen sensor data for the two deployments showing the operation of the control system. The control limits selected allowed the dissolved oxygen to remain within approximately 1 ml/L of the ambient level and still yield data to assess the sediment uptake rate. The multiple cycles for both recharge and uptake were consistent and repeatable.

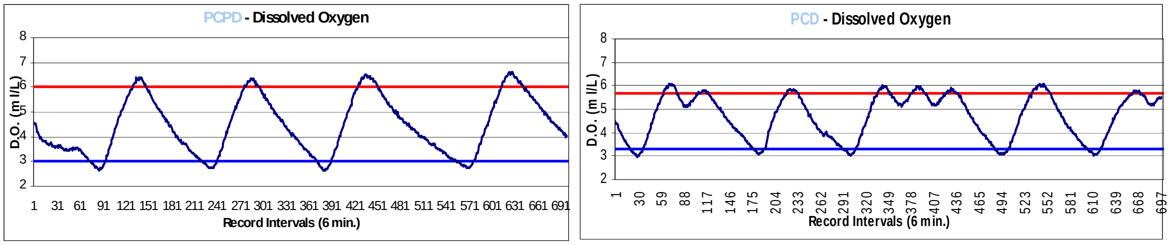


Figure 38. Paleta Creek Metals Demonstrations Oxygen Control Results.

As requested by CA EPA certification evaluators, an independent dissolved oxygen measurement of ambient bottom water at the BFSD2 test site was made during the formal Demonstration deployment. The measurement instrument was battery power-limited and operated for only the first 39 hours of the deployment. During that period, cyclic changes of approximately 0.5 ml/L occurred about the ambient level of approximately 5 ml/L. Thus oxygen results reconfirm that a proper chamber seal was achieved, and that oxygen levels within the chamber were maintained close to the ambient level and with similar, though slightly larger, variability to that observed outside the chamber.

In the properly sealed BFSD 2 chamber, the pH will generally show a decreasing trend as the breakdown of organic matter at the sediment water interface drives CO_2 into the chamber water. This decreasing trend was observed during both deployments as shown in Figure 39. Some small fluctuations from the expected steady decline in chamber pH were seen. While the exact cause of these fluctuations is not known, a number of factors including photosynthetic activity and sediment and pore water oxidation chemistry can account for the minor reversals. In the absence of other evidence of a breech in chamber seal, these small fluctuations were attributed to natural variations.

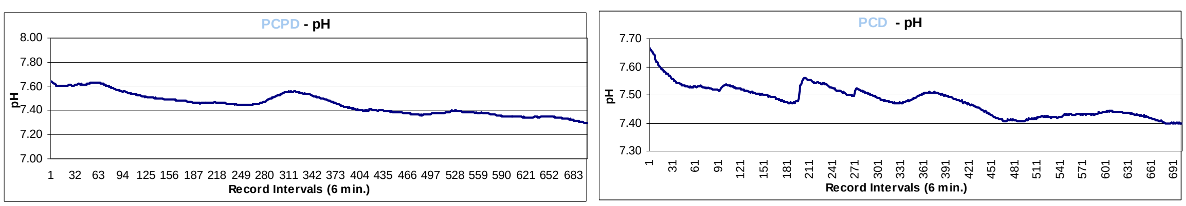


Figure 39. Paleta Creek Metals Demonstrations pH Results.

5.1.3.2.2 Deployment and Recovery Problems

Two minor problems were encountered during the demonstrations. The first was failure of the commercial acoustic recovery system to function. During the Pre Demonstration the failure was attributed to one too many burn-wire strands which led to excessive time for functioning. One strand was removed for the next test, however the release latch mechanism was corroded and failed to release the buoy after the burn-wire had properly functioned. The latch was subsequently modified and is an inspection point as part of the pre-deployment checklist procedure. Most importantly it was determined that abrasive cleaning of the ground (plating) electrode with sandpaper must be performed after every use.

The second problem was the concentration of metals in the water collected from the open chamber, as it descended to the bottom was not consistent with concentrations in the chamber shortly after it reached the bottom. The values from laboratory analysis of the water in sample bottle one (which filled during descent, after manual operation of its valve near the surface) and from water in sample bottle number two (filled from the chamber 6 minutes after lid closure) were inconsistent. As with the blank tests, the concentration values from the second sample bottle were considered more representative of makeup water entering the chamber and were used in dilution correction calculations. And, as with the blank tests, a sensitivity analysis indicated an insignificant affect on flux results. A more acceptable method for collecting representative bottom water was subsequently implemented and test deployed prior to the Pearl Harbor demonstrations.

5.1.3.3 Discussion of Data Interpretation

In order to understand the significance of the measured flux rates in Paleta Creek from a water quality standpoint, it is necessary to estimate the potential loading and subsequent increase in metals concentrations within the overlying water. A simplified analysis is presented here in order to illustrate the utility of the BFSD2 data for this purpose.

The Paleta Creek study area where the demonstrations were performed is bordered by land on three sides, and open to San Diego Bay only to the southwest. The bounded area has a surface area of about 62400 m^2. The average depth of the area is about 7 m, and thus the overall volume is about 436800 m^3. The tidal range in San Diego Bay averages about 1.4 m. A simple estimate of the residence time can be obtained based on complete tidal flushing as

$$\tau_{res} = \frac{V_{pc}}{V_{tp}} = \frac{D_{pc}}{H_t N_t} = \frac{7}{1.4 \times 2} = 2.5\ days$$

Where τ_{res} is the residence time, V_{pc} is the volume of the Paleta Creek study area, V_{tp} is the tidal prism volume for the area, D_{pc} is the depth of the study area, H_t is the tidal range, and N_t is the number of tides per day.

In steady state conditions, the residence time can be related to the overlying water concentration by the relation

$$\tau_{res} = \frac{m_{ow}}{\dot{m}_{sed}}$$

Where m_{ow} is the mass of a given metal in the Paleta Creek study area overlying water, and m_{sed} is the loading from the sediment.

The overlying water concentration can thus be estimated from the flux rates as

$$c_{ow} = \frac{m_{ow}}{V_{pc}} = \frac{\tau_{res}\dot{m}_{sed}}{V_{pc}} = \frac{\tau_{res}F_{sed}A_{pc}}{V_{pc}} = \frac{\tau_{res}F_{sed}}{D_{pc}}$$

Where F_{sed} is the sediment flux rate measured by the BFSD, and A_{pc} is the surface area of the sediment in the Paleta Creek study area. Using this relation, the estimated overlying water concentrations for each of the metals from each of the surveys can be estimated as shown in Table 8 below.

Table 8. Estimated Sediment Flux Contribution to Overlying Water Concentrations for the Paleta Creek Study Area.

Metal	PCPD Flux	PCD Flux	τ_{res}	D_{pc}	C_{ow} PCPD	C_{ow} PCD	C_{ow} meas.	PCPD % of meas.	PCD % of meas.
	μg/m²/day	μg/m²/day	days	m	ug/l	ug/l	ug/l		
Copper (Cu)	-2	-7	2.5	7	-	-	2.41	-	-
Cadmium (Cd)	10	7	2.5	7	0.0036	0.0025	0.0786	4.54%	3.2%
Lead (Pb)	11	4	2.5	7	0.0039	0.0014	0.182	2.16%	0.8%
Nickel (Ni)	25	19	2.5	7	0.0089	0.0068	1.02	0.88%	0.7%
Manganese (Mn)	73	105	2.5	7	0.0261	0.0375	21.0	0.12%	0.2%
Zinc (Zn)	716	575	2.5	7	0.2557	0.2054	8.91	2.87%	2.3%
Silica (SiO_2)	30*	30	2.5	7	0.011 **	0.011 **	0.79 **	1.35%	1.4%

*mg/m²/day **mg/l

Note: C_{ow} measured is the overlying water concentration that was measured during the PCD study. The percent of measured column indicates the fraction of the overlying water concentration that can be explained by the sediment flux.

Comparing the estimated overlying water concentration to the measured concentration indicates that the contribution due to sediment fluxes ranges from a high of 4.5% for cadmium, to a low of about 0.2% for manganese. In practice, these estimates could be used to evaluate the potential benefit of a sediment removal or capping action compared to a no-action scenario. The simple model employed here neglects many factors such a s tidal flushing efficiency of the study area and scavenging of metals near the sediment-water interface that could influence the estimated concentrations. If the tidal flushing is not complete (which is realistic), then the residence time and estimated contribution from the sediments would increase. A typical flushing efficiency is about 50%, which wou ld increase the estimated Cow by a factor of 2. Colloid and particle scavenging near the sediment water interface would tend to reduce the s ediment flux contribution, although the magnitude of this process is not well known.

5.1.4 San Diego Bay, Paleta Creek Organics Demonstration

One 70-hour organics test using Benthic Flux Sampling Device 2 (BFSD2) was conducted March 2-5, 2001 at the heavily industrialized Paleta Creek entrance to San Diego Bay, within the borders Naval Station San Diego. Figure 40 is a picture o f the area which is used for mooring Navy industrial waste and sewage collection barges, emergency oil spill response vessels, and other transient industrial support vessels. The site was selected as one heavily studied over the years and likely to produce detectable and mobile organic contaminants. Also, the site was used for the BFSD2 *metals* flux demonstrations during June, 1998 and has subsequently been designated by the California Regional Water Quality Control Board as San Diego Bay's most "toxic hotspot". A sediment survey of the area conducted by SSC SD during December, 2000 using gravity core samples produced high levels of the US EPA's 16 priority Polynuclear Aromatic Hydrocarbons (PAH) expressed as Total Petroleum Hydrocarbons (TPH). The site was also a convenient location for this first organics field test. The tests were conducted at about 18 +/- 3 feet depth, depending on tidal flow, and offshore from a quay wall about 30 feet. Deployment and retrieval was from the SSC SD research vessel (R/V) Ecos.

Figure 40. Paleta Creek, San Diego Bay.

Prior to the test, the BFSD2 was cleaned and prepared using the same procedures used for the triplicate organics blank tests. Aboard R/V Ecos, after loading and connecting various equipment (laptop computer, TV monitor and light, cabling) a standard pre-deployment checklist was followed. Once moored at the site with the GPS location logged, the BFSD2 (shown in Figure 41) was lowered to near the bottom and the landing

Figure 41. BFSD2 Paleta Creek Organics Deployment.

site was surveyed by remote video for any obstructions or other features which could prevent successful insertion of the collection chamber into the sediment. The BFSD2 was then lowered to the bottom at the maximum rate allowed by the deck hoist (about 1ft/sec) and the landing and insertion were monitored using the video camera. Activation of three battery-powered lights by switches mounted on the chamber at the 3-inch level was verified and used to establish adequate sediment insertion. The landing produced a minimal amount of resuspension. The 15-minute "Sensor Check" program was then started to close the chamber lid, to stabilize the flow-through sensors and to measure the ambient dissolved oxygen level. Closing the chamber lid sealed the chamber and activated collection of an ambient water sample. Measurement of the ambient dissolved oxygen level was used to establish system control limits for maintaining a narrow range of dissolved oxygen in the collection chamber during the 70-hour test. Dissolved oxygen measurements data taken during the test are also used for assessment of sediment oxygen uptake rates.

After establishing and entering the dissolved oxygen control limits into the 70-hour test program and downloading it to the BFSD2, the flux test was started. The initial autonomous functions were monitored from R/V Ecos to assure proper operation of the BFSD2 prior to disconnecting the cables and dropping them overboard. Proper data recording and rotary sample valve commands were confirmed. R/V Ecos departed the site and left BFSD2 in place to perform the 70-hour autonomous sampling operation.

Retrieval of BFSD2 after completion of the test, shown in Figure 42, was routine except for malfunction of the commercial acoustic recovery system (the latch required subsequent modification). Recovery was aided by the clarity of the water and allowed a boat hook to be used to jar the recovery buoy loose from the BFSD2. Once BFSD2 was washed down and on deck, the twelve 250 ml sample bottles were removed for processing using EPA handling and chain of custody procedures. All bottles were full and inline filter elements were slightly discolored, indicating low turbidity within the chamber. Before moving location, a sediment sample was collected from the BFSD2 landing site. Onboard R/V Ecos, the sample bottle filter assemblies were removed and replaced with precleaned caps, preprinted labels were attached to the samples and packaging for overnight shipment was completed.

Figure 42. BFSD 2 Paleta Creek Organics Demonstration Recovery.

As the samples were being processed onboard R/V Ecos, the recorded data files from the 70-hour test were uploaded and entered into a standardized Excel spreadsheet template for data processing. The sensor data, plotted as time-series indicated a successful deployment. As can be seen in Figure 43, there was no sudden pH level shifts indicating loss of chamber seal and the oxygen control system maintained the dissolved oxygen level within the set limits. The slowly reducing trend for pH level was normal and is indicative of biological activity. The slight increases observed in pH near 28 hours and again near 50 hours correspond to midday periods and are most likely associated with benthic algal production and a corresponding consumption of $C0_2$ and increase in pH. Salinity, temperature and pressure were also normal.

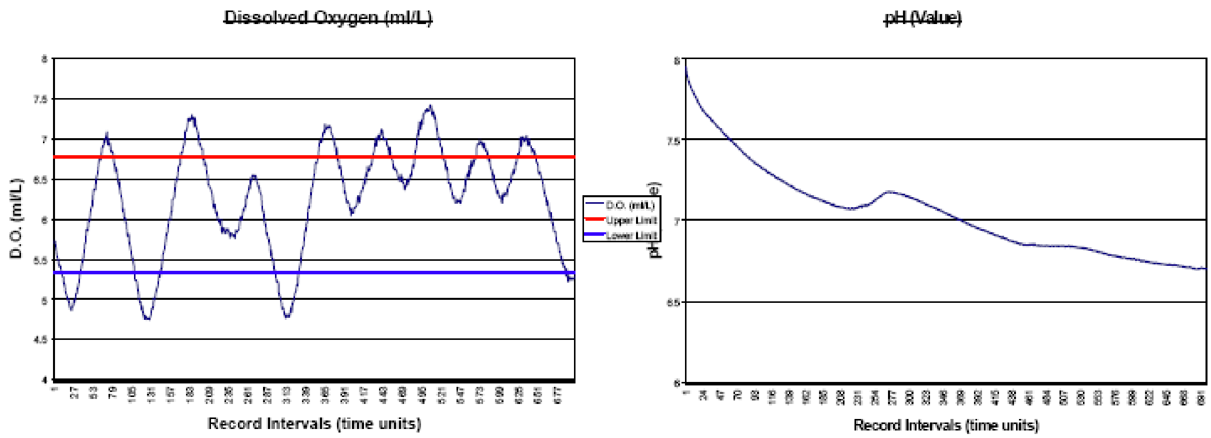


Figure 43. BFSD 2 Paleta Creek Organics Demonstration Recovery.

The samples were packaged and overnight air-shipped that afternoon to ADL for extraction and analysis in accordance with the processes, procedures and controls established under the Method Detection Limit study and used for the triplicate blank tests. All data and results for the demonstration are compiled in Microsoft Excel spreadsheets "PC Organics Demo - PAHs (Part1&2).xls", "PC Organics DemoPCBs.xls" and "PC Organics Demo-Pesticides.xls" provided with the electronic submission of this report. Appendix C provides copies of the spreadsheet results and includes data and graphs for the BFSD2 flow-through sensors.

Tables 9, 10 and 11 provide a summary of the flux results for selected PAHs, PCB congeners and pesticides for the Paleta Creek organics demonstration.

Table 9. BFSD2 PAH Results Summary for Paleta Creek Demonstration.

PAH	Flux	+/- 95% C.L.	Flux Rate Confidence	Triplicate Blank Flux ($ng/m^2/day$)		Bulk Sediment	Overlying Water
	($ng/m^2/day$)*	($ng/m^2/day$)	(%)	Average	+/- 95% C.L.	(ng/g)	(ng/L)
1. Naphthalene	459.20	429.58	94.5%	-440.30	458.38	13	6.7
2. Acenaphthene	337.58	178.97	100.0%	-32.40	50.34	19	9.7
3. Acenaphthylene	105.51	183.82	33.8%	208.47	112.60	220	7.6
4. Fluorene	173.17	149.76	100.0%	-76.74	28.38	34	2.3
5. Phenanthrene	489.25	659.77	100.0%	10.95	10.95	240	8.2
6. Anthracene	569.42	260.29	100.0%	117.68	64.62	470	5.3
7. Fluoranthene	365.55	397.63	100.0%	-1423.95	178.41	890	37
8. Pyrene	951.97	755.67	100.0%	-439.51	70.73	740	13
14. Indeno(1,2,3-c,d)pyrene	-65.35	906.77	NA	NA	NA	470	1.4
16. Benzo(g,h,i)perylene	-46.63	263.97	67.7%	20.15	65.15	400	1.4

Table 10. BFSD2 PCB Results Summary for Paleta Creek Demonstration.

PCB	Flux (ng/m^2/day)*	+/- 95% C.L. (ng/m^2/day)	Flux rate Confidence (%)	Blank Flux (ng/m^2/day) Flux	Blank Flux +/- 95% C.L.	Bulk Sediment (ng/g)	Overlying Water (ng/L)
18 - 2,2',5-Trichlorobiphenyl	52.21	103.93	4%	76.82	36.49	2.6	ND
28 - 2,4,4'-Trichlorobiphenyl	41.52	80.03	61%	-8.05	82.03	2.2	1.1
52 - 2,2',5,5'-Tetrachlorobiphenyl	9.44	105.28	77%	72.74	28.12	4.9	3
66 - 2,3',4,4'-Tetrachlorobiphenyl	-19.94	62.01	96%	37.74	25.45	5.3	ND
101 - 2,2',4,5,5'-Pentachlorobiphenyl	45.99	84.57	17%	57.59	31.49	13	ND
118 - 2,3',4,4',5-Pentachlorobiphenyl	-2.34	123.95	9%	2.51	15.40	13	ND
153 - 2,2',4,4',5,5'-Hexachlorobiphenyl	22.26	78.55	43%	9.45	11.71	23	0.11

Table 11. BFSD2 Pesticide Results Summary for Paleta Creek Demonstration.

Pesticide	Flux (ng/m^2/day)*	+/- 95% C.L. (ng/m^2/day)	Blank Flux (ng/m^2/day) Flux	Blank Flux +/- 95% C.L.	Bulk Sediment (ng/g)	Overlying Water (ng/L)
2,4'-DDT	57.49	95.75	NA	NA	3.6	0.88
4,4'-DDT	31.23	55.47	NA	NA	14	ND
Dieldrin	-23.48	45.68	NA	NA	2	ND
Hexachlorobenzene	23.76	35.20	NA	NA	0.61	ND
Mirex	36.23	154.93	NA	NA	ND	ND

Numbers in the Flux Rate Confidence column indicate the statistical confidence that the measured flux rate is different than the blank flux rate. Results from the blank study, bulk sediment analysis and overlying water are shown for comparison.

Figures 44, 45 and 46 provide graphical comparison of the flux results with the blank tests results.

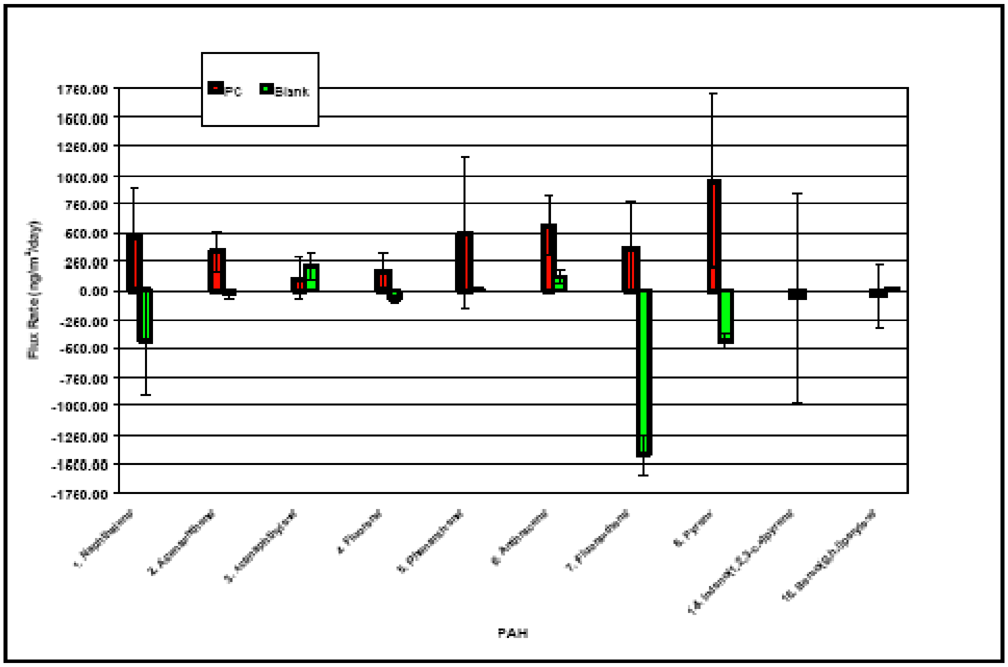


Figure 44. Paleta Creek PAH Demonstration Results.

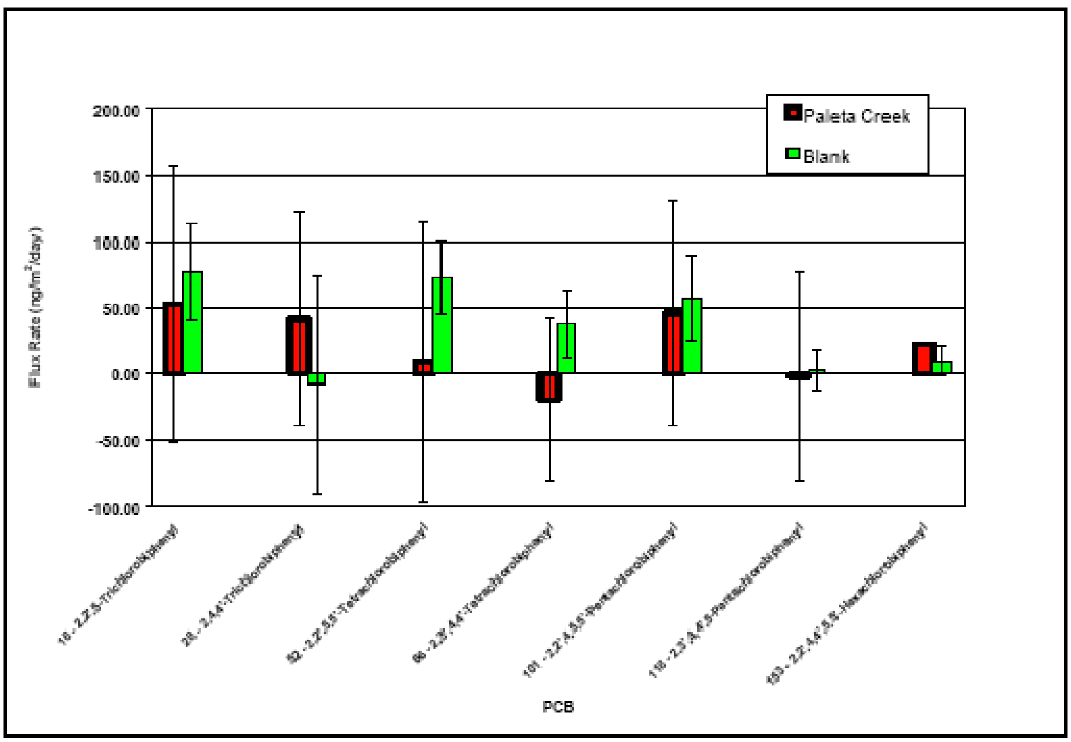


Figure 45. Paleta Creek PCB Demonstration Results.

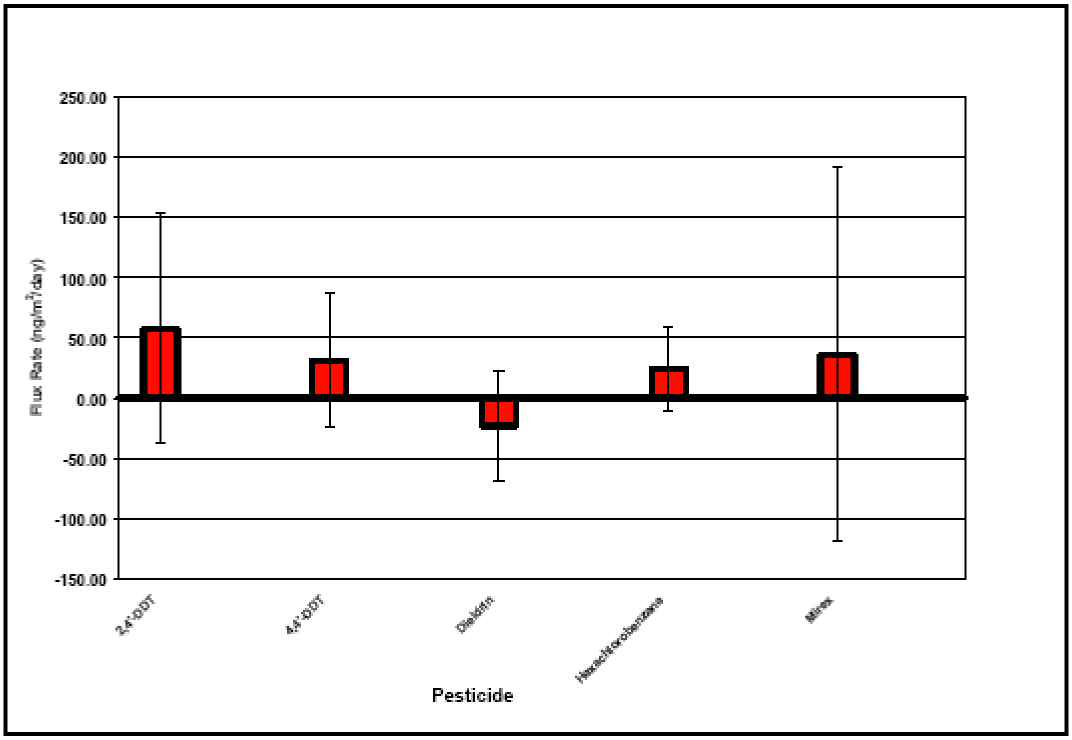


Figure 46. Paleta Creek Pesticide Demonstration Results.

5.1.4.1 Paleta Creek Organics Demonstrations Results

5.1.4.1.1 Polynuclear Aromatic Hydrocarbons (PAHs) Results

Complete individual data sets were obtained for six of the first eight PAHs (Naphthalene, Acenaphthene, Acenaphthylene, Phenanthrene, Fluoranthene and Pyrene). For the two incomplete data sets, non-detects were reported in two samples for Fluorene (samples 4 and 6) and in one sample for Anthracene (sample 2). The non-detects were removed from the data series for flux computations. All trends in concentration change were positive over time (i.e. sediment *release*) and the largest change among the first eight PAHs during the 70-hour test, after correction for dilution, was 18.9 ng/L (parts per trillion) for Phenanthrene. Most of the other PAHs changed less than 10 ng/L. The resulting concentration trends, when compared to the statistically derived triplicate blank test trends showed significant flux for seven of the eight lightest molecular weight PAHs. The confidence that the flux was statistically different than the associated blank was 100% for six of the first eight PAHs and 94.5% for Naphthalene. Acenaphthylene was the only PAH in the first eight with a flux less than the associated blank tests and it had a resultant flux rate confidence of 33.8%. Appendix D ("PC Organics Demo-PAHs (Part 1).xls") includes time-series graphs showing flux and blank tests concentrations over time for the eight lightest molecular weight PAHs. These graphs show reasonable linearity of the time-series flux test data and allow intuitive comparison of the flux and blank test results.

Of the remaining eight targeted PAHs with the heaviest molecular weights all but two were non-detectable throughout the full set of 12 samples. For the two with detects, Indeno(1,2,3-c,d)pyrene yielded four (samples 1,3,5,and 12) and Benzo(g,h,i)perylene yielded five (samples 1,3,5,8,and12) detectable concentrations. Additionally, only Benzo(g,h,i)perylene had adequate blank test results during the earlier triplicate test series for comparison. The Benzo(g,h,i)perylene flux, adjusted for

dilution, was negative (i.e. sediment *uptake*) and in comparison to its blank results there was a 67.7% confidence that the flux is different than the blank results. Indeno(1,2,3-c,d)pyrene also indicated a negative flux and there is no blank results for comparison. The time-series graphs included in Appendix D ("PC Organics Demo-PAHs (Part 2).xls") show the slight negative slopes, or concentration changes over time, for these two heavier molecular weight PAHs.

5.1.4.1.2 Polychlorinated Biphenyl (PCB) Congeners Results

Seven PCB congeners yielded sufficiently complete data sets for flux computations. PCB #28 (2,4,4'-Trichlorobiphenyl) yielded a complete set of 12 detectable concentration values. PCBs # 18 (2,2',5-Trichlorobipheny) yielded 9 samples with detectable concentration levels, #52 (2,2',5,5'-Tetrachlorobiphenyl) yielded 11 samples with detectable concentration levels, #66 (2,3',4,4'-Tetrachlorobiphenyl) yielded 10 samples with detectable concentration levels, #101 (2,2',4,5,5'-Pentachlorobiphenyl) yielded 8 samples with detectable concentration levels, #118 (2,3',4,4',5-Pentachlorobiphenyl) yielded 8 samples with detectable concentration levels, and #153 (2,2',4,4',5,5'-Hexachlorobiphenyl) yielded 11 samples with detectable concentration levels. In most cases, the partial data sets were composed of consecutive sample detects following initial non-detects in the series. As with PAHs, the non-detects were removed from the data series for flux computations. Five of the seven PCBs exhibited a positive trend in concentration over time (i.e. sediment *release*) and two exhibited a negative trend (i.e. sediment *uptake*). Three of the five PCBs indicating sediment release exhibited flux levels higher than the associated blank test levels and two were lower. The two PCBs indicating negative flux (sediment *uptake*) had positive blank test flux values. All changes in PCB concentration over the 70-hour test were less than 2 ng/L (parts per trillion) with the largest change (approximately 1.5 ng/L) exhibited by PCB #52. Statistical flux confidence is not high for six of the computed flux values when compared to associated blank test results. Statistical flux confidence for PCB#66 (2,3',4,4'-Tetrachlorobiphenyl) was 96%, however negative, or *uptake*, value introduces concern of validity and may be the result of the low concentrations measured. Appendix D ("PC Organics Demo-PCBs.xls") includes time-series graphs showing flux and blank tests concentrations over time for the seven PCBs with detectable concentrations. These graphs show marginal linearity of the time-series flux and blank test data resulting from the very low concentrations measured. Intuitive comparison of the flux and blank test results is illustrative of the low computed flux confidence levels reported in Table 10.

5.1.4.1.3 Pesticide Results

Five pesticides yielded sufficiently complete data sets for flux computations. 2,4 DDT yielded 11 samples with detectable concentration levels, 4,4 DDT yielded 9 samples with detectable concentration levels, Dieldrin yielded 8 samples with detectable concentration levels, Hexachlorobenzene yielded 11 samples with detectable concentration levels and Mirex yielded 6 samples with detectable concentration levels. Again, as with PCBs, the partial data sets consisted of consecutive sample detects following initial non-detects in all series except for Mirex. Mirex had a one sample data gap in an otherwise consecutive series. And again, the non-detects were removed from the data series for flux computations. One additional measurement (sample 6) of the Hexachlorobenzene data set was removed because it exceeded all other data in the set by an order of magnitude and introduced a large trend offset. Four of the five pesticides exhibited a positive trend in concentration over time (i.e. sediment *release*) and one, Dieldrin, exhibited a negative trend (i.e. sediment *uptake*). There were insufficient blank test samples with detectable concentrations of these five pesticides to compute comparable blank flux performance. All changes in pesticide concentration over the 70hour test were less than 2 ng/L (parts per trillion) with the largest change (approximately 1.8 ng/L) exhibited by 2,4'-DDT. Appendix D ("PC Organics Demo-Pesticides.xls") includes time-series graphs showing flux and blank tests concentrations over time for the five

pesticides with detectable concentrations. These graphs show reasonable linearity of the time-series flux with consideration of the very low concentrations measured.

5.1.4.2 Interpretation of Paleta Creek Organics Results

Whereas the flux results for the lighter molecular weight PAHs indicate greater mobility from the sediment into the overlying water than the heavier compounds, the measured concentration of the heavier molecular weight PAHs in samples extracted from the bulk sediment were generally higher than those of the lighter compounds. It appears that the heavier molecular weight PAHs are significantly less mobile, even with higher concentrations in the bulk sediment, than the lighter compounds. Comparison of this finding with solubility measurements of the targeted PAHs in seawater shows the same trend: the heavier molecular weight PAHs are far less soluble. A unilateral reduction in solubility of approximately five orders of magnitude occurs from lightest-to-heaviest for the 16 targeted PAHs. This relationship between PAH flux and PAH solubility does not appear to be exclusive of other factors however. For example, Pyrene (a four-ring compound with a molecular weight of 202) had a flux rate of 952ng/m^2/day which is more than twice that of Naphthalene (a two-ring compound with a molecular weight of 128) with a flux rate of 459ng/m^2/day. This result is likely driven by the bulk sediment concentration of Pyrene which was about of 57 times larger than Naphthalene (740ng/g vs 13ng/g). It appears that the flux of a PAH from the sediment into the overlying water remains dependant, in part, on the level of bulk concentration in the sediment. Thus even a low mobility, heavier molecular weight PAH with a high enough concentration in the sediment may flux into the overlying water at a higher rate than a lighter compound at lower concentrations. For the Paleta Creek test, it appears that the generally higher sediment concentrations of the heavier targeted PAHs were still too low to produce measurable concentrations. This then suggests that for PAHs in sediments, the PAH flux will vary in direct proportion to molecular weight and solubility leading to preferential removal of low molecular weight PAHs, and a relative increase in the bulk sediment fraction of the heavy molecular weight PAHs. Reduction of PAH concentrations at the sediment surface due to these diffusive fluxes will lessen, over time, the concentration levels of PAHs available for biological uptake. This reduction when combined with other natural attenuation factors such as infaunal irrigation and bacterially mediated degradation may be considered as a possible strategy for sediment remediation. Providing that risk levels are not exceeded, flux results for PAHs can be used to estimate the time required to reduce bulk sediment concentrations in the biologically active region of the sediment to acceptable levels.

The above discussion also generally applies to PCBs. The mobility of PCBs as indicated by the flux results was generally in direct proportion to solubility and in inverse proportion to molecular weight. The concentration values for the overlying water and bulk sediment were also generally consistent with trends identified with PAHs. The very low concentration levels of the PCBs in the Paleta Creek sediments introduced considerable uncertainty but a general trend is evident.

Pesticides may behave as above, however molecular weight relationships are difficult to establish with the wide range and complexity of such compounds. And, as with PCBs, the low concentration levels measured in this test introduce considerable uncertainty but still allow identification of a general trend.

5.1.4.3 Conclusions for Paleta Creek Organics Demonstration Test

The measurement of the mobility of organic compounds from contaminated sediments at the Paleta Creek location within Naval Station San Diego was successfully achieved. The measurements, when compared to triplicate blank test results resulted in quantification of statistically significant values with high confidence primarily for Polynuclear Aromatic Hydrocarbons (PAHs) fluxing into

overlying water. The complete range of targeted PAHs, Polychlorinated Biphenyl (PCB) Congeners and pesticides were not measured either because they were not present or because they were below analytical detection limits. PCBs and pesticides, where present and measurable, had very low concentrations which introduced significant data scatter and low statistical confidence levels. Some flux measurements of PCBs and all pesticides did not have blank test results for comparison. Future site measurements of known or suspected contaminants for which blank test results are not available would benefit from blank tests using spiked concentrations of targeted contaminants.

5.1.5 Pearl Harbor, Hawaii Metals Demonstrations

70-hour metals demonstrations using BFSD2 were conducted at two different sites in Pearl Harbor, Oahu, Hawaii during February 1999. The BFSD2 deployments were conducted as part of a combined demonstration with integrated sediment investigation technologies and included site screening prior to both BFSD2 deployments.

The first test was conducted Feb. 5-8, 1999 within the Naval Inactive Ship Mooring Facility (NISMF) at Middle Loch where approximately 70 moored ships await disposition (disposal, sale, temporary storage, etc.). The area is quiescent and approximately 26 feet deep with murky water and fine-grained sediment overlain with an easily disturbed 1-2 foot flocculent layer. Reports of sediment depths over 100 feet were not confirmed but are believable. Some benthic organisms were found in the sediment during screening. All work at the site was accomplished from an open-deck, 35-foot Navy workboat operated by enlisted personnel, see Figure 47. A portable generator was used to power the video monitor, underwater light and laptop computer during deployment, however for recovery all electrical connections were made after reaching the shore facility.

Figure 47. BFSD2 Pearl Harbor, Middle Loch Metals Demonstration.

The second metals test was conducted Feb. 11-14, 1999 within the area known as Alpha Docks, Marine Diving and Salvage Unit One (MDSU-1) located at Bishop Point on the entrance channel to the harbor, Figure 48. Again, historical, RI and screening data indicated elevated levels of trace

metals present in the sediment. This area is an active industrial location and included several Navy housing barges, which are moved about by tugboats. The area has a depth of approximately 25 feet with generally clear water and medium- to fine-grained sediments. Tidal currents are enough to minimize any flocculent layer. Some benthic organisms were found during sediment screening. The Navy workboat was used as before for deployment but because of proximity to the quay wall recovery was accomplished from shore using an 80-foot crane.

Figure 18. BFSD2 Pearl Harbor, Bishop Point Metals Demonstration.

Prior to both tests, the BFSD2 was cleaned and prepared using the same procedures used during triplicate metals blank tests as well as other deployments and demonstrations. For the first deployment at NISMF, Middle Loch cleaning was accomplished at SSC SD prior to loading the BFSD2 into its re-usable shipping container, Figures 49 and 50. The shipping container, designed for compatibility with commercial air cargo carriers, includes compartments, shelving and storage bays sufficient for shipment of BFSD2 as well as all materials and supplies required for extended field operations. Shipping weight was approximately 1450 pounds. For safety reasons the compressed oxygen cylinder was vented to less than 250 psi and no hazardous materials (i.e. Nitric Acid for cleaning and sample preservation) were air-shipped. The container proved convenient for onsite access and minimized working space requirements. After arrival and unpacking, system checks and oxygen bottle refilling operations preceded. Nitric acid was secured from the local Navy environmental laboratory.

Figure 49. BFSD2 Container, Front View.

Figure 50. BFSD2 Container, Back View.

Aboard the Navy workboat, after loading and connecting various equipment (laptop computer, TV monitor and light, cabling) to the portable generator, a standard pre-deployment checklist was followed. At the site, after tying off, lowering the bow platform and logging the GPS location, the BFSD2 was lowered by hand wench to near the bottom and either slowly lowered into the sediment (to minimize disturbance and maintain video coverage: as at Middle Loch) or released from about 2 feet for free-fall (to assure insertion when video coverage can be maintained as at Bishop Point). Activation of the battery-powered insertion lights by switches mounted on the chamber at the 3- inch level was verified and used to establish adequate sediment insertion. Once on the bottom a 15-minute program was started to stabilize the flow-through sensors and to measure the ambient

dissolved oxygen level. After entering the dissolved oxygen control limits into the 70-hour test program, downloading and verifying it, the test was started after visibility conditions for lid closure were confirmed. After starting the program, lid closure (which also activates #1 sample bottle) was viewed and commands for circulation pump activation (at 10 minutes) and sample valve activation (at 16 minutes) for sample bottle number two was monitored before disconnecting for autonomous operations. The disconnected cables were plugged, coiled and cast overboard in a direction away from the BFSD2. Both demonstration deployments were straightforward and without problems. For both tests, the BFSD2 was returned to the shore facility for all data recovery. After freshwater washdown and cleanup the twelve 250 ml sample bottles were removed for processing using EPA handling and chain of custody procedures. Pre-acidified 125ml containers were filled and capped, labeled, logged and refrigerated for subsequent analytical laboratory metals analysis. The remaining sample volume was used to measure silica concentrations with the field portable Hach model DR2010 Instrument. The silica concentrations plotted against time and the BFSD2 pH and dissolved oxygen sensor data, also plotted against time were reviewed for any possible sample compromise prior to shipment to the analytical laboratory. Tables 12 and 13 summarize the results of the Pearl Harbor Middle Loch and Bishop Point metals demonstrations.

Table 12. BFSD2 Results for Pearl Harbor Middle Loch (PHML) Metals Demonstration.

Metal	Flux	+/- 95% C.L.	Flux rate Confidence	Triplicate Blank Flux ($\mu g/m^2/day$)		Bulk Sediment	Overlying Water
	($\mu g/m^2/day$)	($\mu g/m^2/day$)	(%)	Average	+/- 95% C.L.	($\mu g/g$)	($\mu g/L$)
Copper (Cu)	14.79	3.46	99.9%	2.82	8.73	195	0.80
Cadmium (Cd)	1.80	0.31	100.0%	-0.52	0.75	0.2	0.02277
Lead (Pb)	-0.12	0.43	95.2%	3.16	1.59	34	0.03879
Nickel (Ni)	27.17	15.91	100.0%	10.28	7.34	214	0.9472
Manganese (Mn)	-468.18	683.35	97.9%	-264.85	7.49	1180	52.19
Manganese (Mn)[1]	2131.59	904.57	100.0%	-264.85	7.49	1180	52.19
Zinc (Zn)	49.74	17.25	93.5%	-3.38	65.22	314	2.28
Other							
Oxygen (O_2)* (*$ml/m^2/day$)	-1085.52	64.84	na	na	na	na	4.17
Silica (SiO_2)* (*$mg/m^2/day$)	65.03	42.43	100%	-1.97	2.88	na	1.19

1. Mn flux calculated on the basis of first five samples due to non-linearity

Table 13. BFSD 2 Results for Pearl Harbor, Bishop Point (PHBP) Metals Demonstration.

Metal	Flux ($\mu g/m^2/day$)	+/- 95% C.L. ($\mu g/m^2/day$)	Flux rate Confidence (%)	Triplicate Blank Flux ($\mu g/m^2/day$) Average	Triplicate Blank Flux +/- 95% C.L.	Bulk Sediment ($\mu g/g$)	Overlying Water ($\mu g/L$)
Copper (Cu)	112.46	17.60	100.0%	2.82	8.73	241	0.36
Cadmium (Cd)	1.85	1.96	99.4%	-0.52	0.75	0.3	0.009
Lead (Pb)	0.71	1.11	78.7%	3.16	1.59	93	0.06519
Nickel (Ni)	21.04	15.41	96.3%	10.28	7.34	42.9	0.3934
Manganese (Mn)	223.33	284.79	100.0%	-264.85	7.49	324	1.78
Manganese (Mn)[1]	2177.45	192.60	100.0%	-264.85	7.49	324	1.78
Zinc (Zn)	191.18	54.07	100.0%	-3.38	65.22	304	1.43
Other							
Oxygen (O_2)* (*ml/m^2/day)	-567.12	54.96	na	na	na	na	6.5
Silica (SiO_2)* (*mg/m^2/day)	118.61	27.62	100%	-1.97	2.88	na	0.31

1. Mn flux calculated on the basis of first three samples due to non-linearity

Numbers in the Flux Rate Confidence column indicate the statistical confidence that the measured flux rate is different than the blank flux rate. Results from the blank study, bulk sediment analysis, overlying water and oxygen uptake analysis are shown for comparison.

The results for Middle Loch indicate that Copper, Cadmium, and Nickel had fluxes out of the sediment that were highly significant when compared to the blank chamber results. Zinc also showed an outward flux but the statistical confidence was somewhat lower, and compared to blank results, any zinc flux is inconclusive. Lead had a negative flux (sediment uptake) but the statistical confidence was again somewhat lower. The flux of Manganese was negative when calculated using all the samples, but was positive when using only the first five samples. After the first five samples, the Manganese concentration in the chamber dropped dramatically. The reason for this drop is not known, and this effect and subsequent handling of the data are discussed in the Paleta Creek discussion in Section 5.1.3.1. The Silica flux was out of the sediment and was highly significant when compared to blank results. Dissolved Oxygen indicated a sediment uptake.

The results for Bishop Point were significantly different than those of Middle Loch with the exception of Cadmium, which was nearly identical. Copper, Cadmium, Manganese and Zinc all had fluxes out of the sediment that were highly significant when compared to the blank chamber results and the magnitude of the Copper and Zinc fluxes were markedly higher than those observed for Middle Loch. The Nickel flux however was somewhat less and with a reduced confidence. Lead fluxed outward at Bishop Point, but confidence is only marginal when compared to blank chamber results. As with Middle Loch, the Manganese flux at Bishop Point was non-linear and the concentration in the chamber leveled off after the third sample. The Manganese flux calculated using only the first three samples is similar to the flux estimated using the first five samples at Middle Loch and similar to that measured at other sites. The flux calculated using all the samples is low but still positive. The Silica flux results were again highly significant compared to blank results and were

higher than Middle Loch. The Dissolved Oxygen sediment uptake was about half that of Middle Loch. Figures 50 and 51 belographically illustrate results

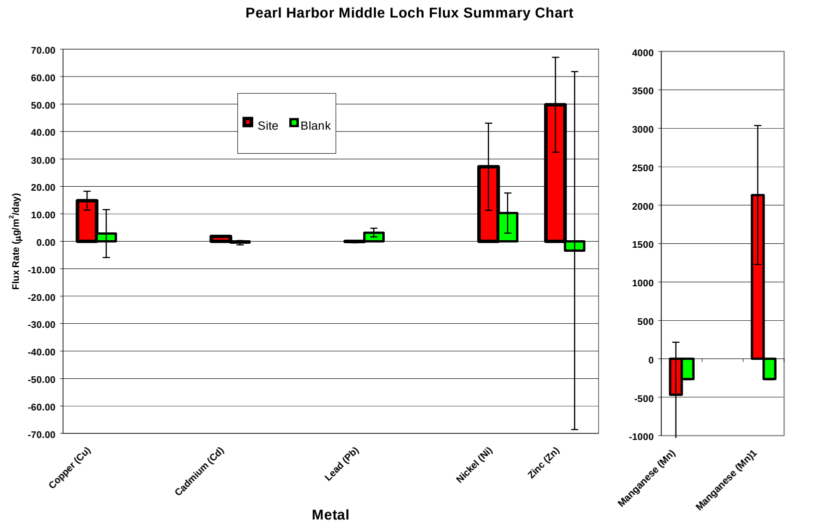


Figure 51. Pearl Harbor Middle Loch Demonstration Results.

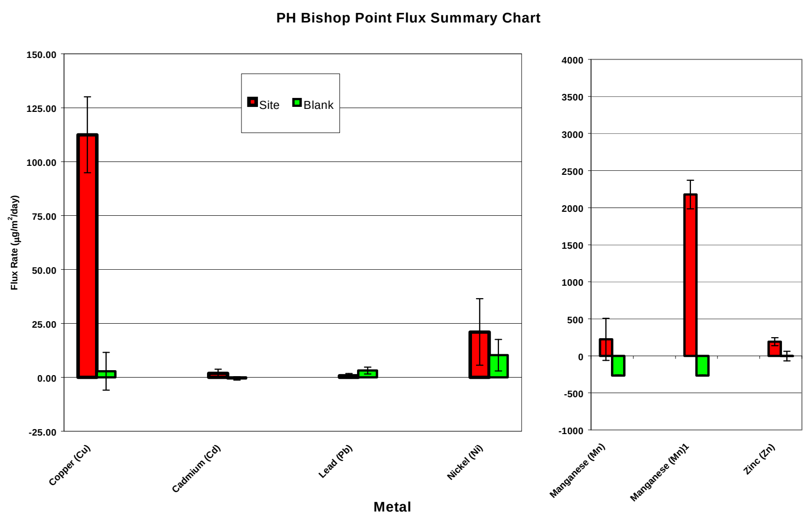


Figure 52. Pearl Harbor Bishop Point Demonstration Results.

5.1.5.1 Discussion of Pearl Harbor Metals Demonstrations Results

In general, BFSD2 results from the two Pearl Harbor demonstration locations were significantly different than one another. Figures 53 and 54 are the sets of graphs of concentration versus time for each analyte in each of the demonstrations, compared with blank performance. The results for the Middle Loch demonstration indicate that Copper, Cadmium, and Nickel had fluxes out of the sediment that were highly significant when compared to the blank chamber results. Zinc also indicated an outward flux but the statistical confidence was low suggesting no conclusive flux rate. Zinc concentrations in Middle Loch were low compared to other sites and most likely not a problem

in this area. Lead had a negative flux (sediment uptake) but the statistical confidence was again somewhat lower. Manganese flux trends were similar to those observed in Paleta Creek and discussed in Section 5.1.3.1. The flux of Manganese was lower, even negative, when calculated using all the samples, but was positive when using only the first five samples. After the first five samples, the Manganese concentration in the chamber dropped dramatically. The Silica flux was out of the sediment and was highly significant when compared to blank results. Dissolved Oxygen indicated a sediment uptake.

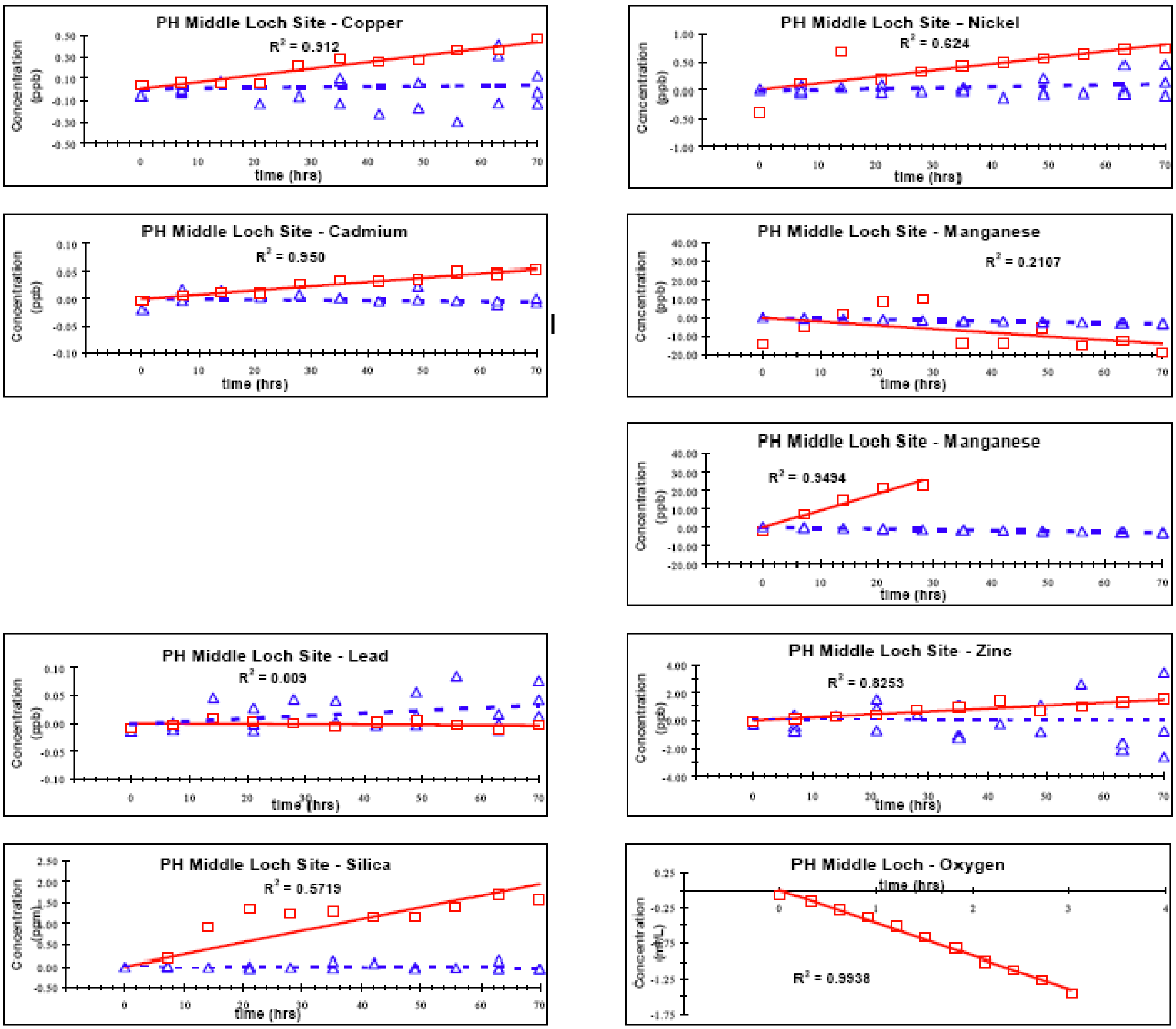


Figure 53. Pearl Harbor Middle Loch Demonstration Concentration vs. Time.

The results for Bishop Point were significantly different than those of Middle Loch with the exception of Cadmium, which was nearly identical. Copper, Cadmium, Manganese and Zinc all had fluxes out of the sediment that were highly significant when compared to the blank chamber results and the magnitude of the Copper and Zinc fluxes were markedly higher than those observed for Middle Loch. The Nickel flux however was somewhat less and with a reduced confidence. Lead

fluxed outward at Bishop Point, but confidence is only marginal when compared to blank chamber results. As with Middle Loch, the Manganese flux at Bishop Point was non-linear and the concentration in the chamber leveled off after the third sample. The Manganese flux calculated using only the first three samples is similar to the flux estimated using the first five samples at Middle Loch and similar to that measured at other sites. The flux calculated using all the samples is low but still positive. The Silica flux results were again highly significant compared to blank results and were higher than Middle Loch. The Dissolved Oxygen sediment uptake was about half that of Middle Loch.

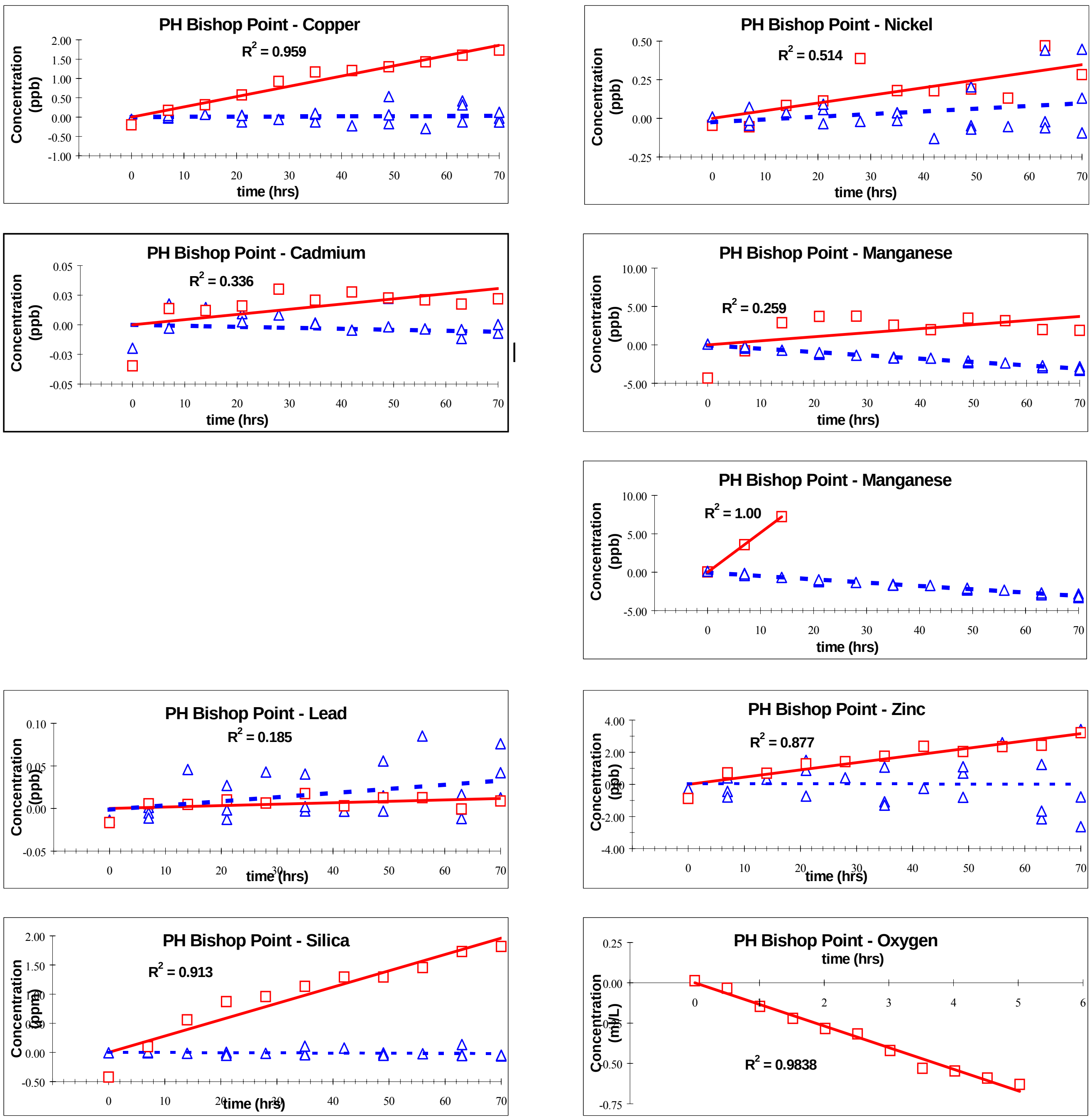


Figure 54. Pearl Harbor Bishop Point demonstration Concentration vs. Time.

5.1.5.1.1 Metals Flux Measurements

Flux measurements were made for the metals cadmium, copper, lead, nickel, manganese and zinc. As shown in Tables 12 and 13, and illustrated in Figures 51 through 54, the BFSD2 results from the two Pearl Harbor demonstrations were significantly different from one another and from previous surveys.

Middle Loch fluxes were lower than those of Bishop Point, with the exception of Nickel (which was slightly higher). Of interest is that the Manganese flux at Middle Loch was initially almost the same (during the first 28 hours) as that at Bishop Point during the first 14 hours and then both exhibited an abrupt downward change. Possible explanations for this observation include complex reduction-oxidation interactions, sulfide binding, complexation with organic matter, or elevated water column concentrations associated with hull leachate sources at the sediment interface. The concentration-time graphs for both Manganese and Silica at Middle Loch show similar “quenching” trends, which are also apparent to a lesser degree in comparable data from Bishop Point.

Bishop Point fluxes were all outward and larger in magnitude than Middle Loch (except Nickel, as mentioned above). Copper, Cadmium, Manganese and Zinc all had fluxes out of the sediment that were highly significant when compared to the blank chamber results and the magnitude of the Copper and Zinc fluxes were markedly higher than those observed for Middle Loch. The Nickel flux however was somewhat less and with a reduced confidence. Lead fluxed outward at Bishop Point, but confidence is only marginal when compared to blank chamber results. With consideration for the more subtle Manganese and Silica “quenching” trends and the relatively lower oxygen uptake rate at Bishop Point, the fluxes appear to be less affected by possible interactions and are mobilizing from the sediment more linearly. The larger sediment grain sizes and size distribution at Bishop Point, as determined during site screening, may also be contributing to the apparent linear mobility of the outward fluxing metals.

As with Middle Loch, the Manganese flux at Bishop Point was non-linear and the concentration in the chamber leveled off after the third sample. The Manganese flux calculated using only the first three samples is similar to the flux estimated using the first five samples at Middle Loch and similar to that measured at other sites. The flux calculated using all the samples is low but still positive. The Silica flux results were again highly significant compared to blank results and were higher at Bishop Point than Middle Loch. The Dissolved Oxygen sediment uptake at Bishop Point was about half that of Middle Loch.

5.1.5.2 Discussion of Pearl Harbor Metals Demonstration Tests

Important aspects of the demonstrations including performance indicators and deployment problems are discussed below.

5.1.5.2.1 Performance Indicators

As discussed in Section 5.1.2.2.1, several methods were used to assure system performance of the BFSD 2 during and after the demonstrations. In both deployments the landing and insertion, monitored with the video camera and landing lights, indicated a good penetration and after the test was started, the video camera also confirmed successful lid closure. At Middle Loch the “soft” landing approach was used to minimize disturbance of the flocculent layer and maintain maximum visibility in the already murky water. Penetration was about twice normal (approximately 6 inches) and all visibility was lost. Test start and lid activation was delayed (about 15 minutes) until the water cleared enough to confirm closure. At Bishop Point a “free fall” landing approach was used from

about one foot above the sediment without significant loss of visibility. The resulting outward-traveling small cloud of disturbed sediment clearly showed the “low bow-wave” design of the BFSD2 to function effectively. The color underwater video camera made viewing this performance possible.

A monotonic increase in silica during the demonstrations was used as another indicator of proper system performance and chamber seal. As shown in Figures 50 and 51, for both deployments the silica concentration increased over the duration of the test indicating proper system performance and chamber seal. The flux magnitudes were high compared to previous mainland surveys, and may be explained by the tropical conditions (i.e., calciferous-rich). Bishop Point Silica results were reasonably linear, but Middle Loch Silica flux was not. Following a rate of increase during the first 24 hours of almost twice that of Bishop Point, Middle Loch Silica flux slowed significantly for the remainder of the test. The non-linearity in both Silica and Manganese fluxes suggest that as the concentrations in the chamber build, the fluxes may be altered by the presence of the chamber itself. This could be attributed either to time/concentration dependent reactions within the chamber, or changes in fluxes due to changes in the gradient between the porewater and the overlying water trapped within the chamber.

The Dissolved Oxygen level in the chamber was monitored and recorded to assure maintenance of ambient oxygen levels, proper chamber seal, and to evaluate sediment oxygen uptake. The rate of oxygen consumption (sediment uptake) during the deployments, was shown in Figures 53 and 54, and was sufficient to cause repeated cycling of the BFSD2 oxygen control subsystem. Figure 55 are graphs of the oxygen sensor data for the two deployments showing the operation of the control system. The control limits selected allowed the dissolved oxygen to remain within approximately 1 ml/L of the ambient level and still yield data to assess the sediment uptake rate. Functioning of the system in this manner assured that chamber isolation of the water was maintained. The ambient oxygen level at Middle Loch was about one half that of Bishop Point and the sediment uptake rate was about twice that of Bishop Point. These conditions, when combined with the pH results discussed below indicate Middle Loch has a higher level of organic decomposition. Again, this is reasonable when considering the differences between the sites.

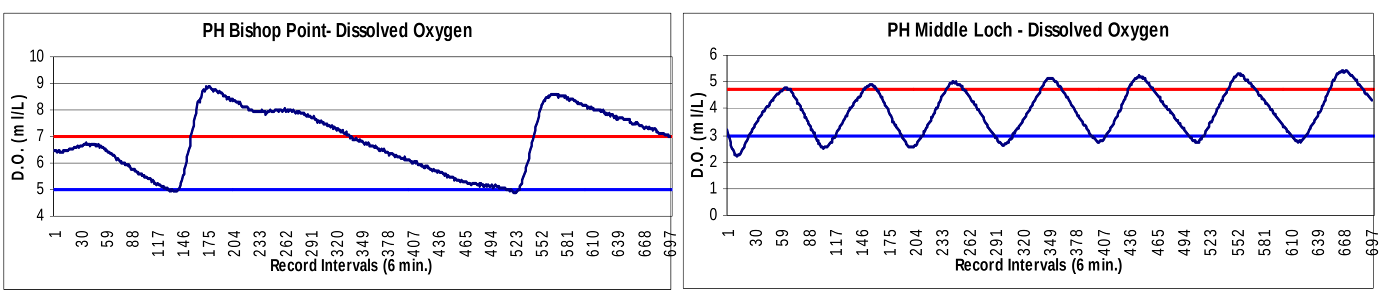


Figure 55. Pearl Harbor Demonstrations Oxygen Control Results.

The pH level in the chamber was monitored and recorded as another assurance indicator of seal integrity. In a sealed BFSD2 chamber, the pH will generally show a decreasing trend as the breakdown of organic matter at the sediment water interface drives CO_2 into the chamber water. This decreasing trend was observed during both deployments as shown in Figure 56. And, as would be expected from results of oxygen uptake discussed above, the pH level dropped at a higher rate throughout the entire 70-hour test duration at Middle Loch.

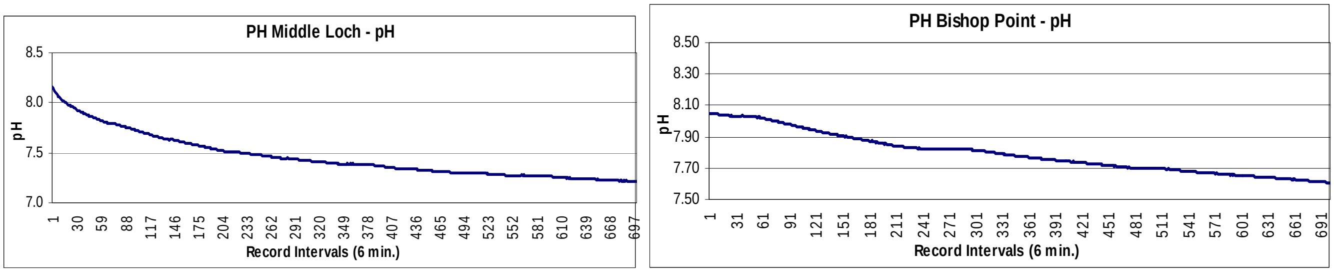


Figure 56. Pearl Harbor Demonstrations pH Results.

5.1.5.2.2 Deployment and Recovery Problems

One minor problem was encountered during recovery at the Middle Loch demonstration and no deployment problems were encountered at either site and. At Middle Loch the commercial acoustic recovery system failed to function following several transmissions of the coded signal. Diver assistance was required to deploy the marker buoy and routine recovery operations were then followed. Subsequent analysis indicated absorption of the acoustic energy by the sediment due to the depth of BFSD2 insertion (almost covering the acoustic receiver window) and a near overhead aspect during transmission. Use of a standoff distance from the approximate location of the BFSD2 for future tests will minimize reoccurrence. Buoy activation was normal (within 8 minutes) after the Bishop Point deployment.

5.1.5.3 Discussion of Metals Data Interpretation

Although the measurements from Pearl Harbor are limited to two locations, they provide significant insight into the importance of understanding contaminant mobility. One way to interpret the flux chamber measurements for Pearl Harbor is to evaluate them in the context of the exposure pathways defined in the RI study. In the RI study, sight-specific Biota-to-Sediment Accumulation Factors (BSAFs) were developed by comparing the tissue burdens of wild-caught organisms to the sediment concentrations found in the same region. In this approach, 100% of the tissue burden is attributed to sediment exposure. One of the primary pathways of sediment exposure is thought to be via remobilization of chemicals to the dissolved phase and subsequent uptake by the organism. The results from the flux chamber measurements allow us to quantify and examine this key pathway.

As an example, we can consider the potential exposure for copper in sediments at the two sites. A cursory examination of the bulk sediment data in Tables 7 and 8 indicate that the exposure levels at the two sites would be about the same, with a slightly lower level at Middle Loch than at Bishop Point. Thus the predicted bioaccumulation for the two sites would also be similar. However, examination of the flux rates for copper at the two sites suggests a much different scenario. The flux rate of copper at Middle Loch was much lower than the flux rate measured at Bishop Point. This indicates that the bulk sediment levels at the two sites do not necessarily reflect the exposure potential. This is further supported by evaluation of the bulk sediment data on a scale normalized for iron content. This analysis indicates that while the levels of copper at Middle Loch fall along the ambient trend, the copper levels at Bishop Point have sources of copper beyond that available from background weathering as shown in Figure 57. In addition, the high oxygen uptake rates at Middle Loch indicate presence of reducing sediments that are likely to contain strong copper binding phases such as sulfides.

These results suggest consideration of a refined exposure model for organisms where the primary exposure is thought to be via the dissolved phase. For example, using the measured flux rates for

copper, the contribution of the sediments to the water can be estimated. This would then be used to quantify the fraction of the biological exposure that could be attributed to this pathway. If this exposure mechanism cannot account for observed uptake or effects, then other pathways or sources must be considered.

Thus the flux rate measurements at the two Pearl Harbor sites illustrate the usefulness of the system in identifying and quantifying exposure pathways between sediments and organisms. The flux results are also consistent with existing knowledge of sediment geochemistry. The results suggest that incorporation of flux measurements on a broader scale will help to improve ecological risk assessments by providing stronger links between bulk sediment chemistry and biological exposure

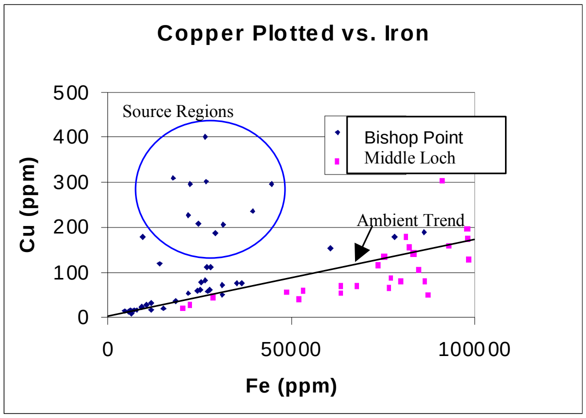


Figure 57. Pearl Harbor Demonstration Data with Iron-Normalized Bulk Sediment Copper Concentrations.

5.1.6 Pearl Harbor, Hawaii Organics Demonstration

One 72-hour test to demonstrate the application of the Benthic Flux Sampling Device 2 (BFSD 2) in *organics*-contaminated sediments was conducted September 7-10, 2001. The test was conducted at the Navy's Marine Diving and Salvage Unit 1 (MDSU-1) facility located at Bishop Point, Pearl Harbor, Hawaii. Pearl Harbor is identified on the National Priority List (Super Fund) for environmental cleanup and is currently completing a four-year Remediation Investigation (RI) study. The site was selected based on RI results and field screening results conducted in February 1999. It had also been previously used for BFSD2 metals-contaminated sediment studies and provided excellent test conditions (access, support, facilities). The MDSU-1 area is an active industrial location and includes several Navy housing barges, which are periodically moved by tugboats. The area has a depth of approximately 25 feet with generally clear water and medium- to fine-grained sediments. Tidal currents are enough to minimize any flocculent layer. The Alpha Dock site selected is near the site used for the metals test and was close enough to the quay wall to allow both deployment and recovery from shore using an 80-foot crane (See Figure 58).

Figure 58. BFSD2 Pearl Harbor, Bishop Point Organics Demonstration.

The BFSD2 was cleaned and prepared at Space and Naval Warfare Systems Center, San Diego (SSC SD) using the same procedures used during triplicate blank tests and the first organics demonstration. It was then loaded into its re-usable shipping container for air-shipment to Hawaii. The shipping container, designed for compatibility with commercial air cargo carriers, includes compartments, shelving and storage bays sufficient for shipment of BFSD2 as well as all materials and supplies required for extended field operations. Shipping weight was approximately 1450 pounds. For safety reasons the compressed oxygen cylinder was vented to less than 250 psi and no hazardous materials were air-shipped. The container is convenient for onsite storage and access and minimizes working space requirements. After arrival and unpacking, system checks were performed to assure no degradation during shipment had occurred. Oxygen bottle refilling was a problem in that compressed-gas suppliers were not willing to fill the small SCUBA-type cylinder and recreational dive shops would fill it but didn't carry pure oxygen. The problem was resolved when vandals stole the tank and refill fittings from the rental car trunk. A new, air-filled small dive tank was purchased as a replacement. It was recognized that the lower oxygen content of the compressed air would be marginal in maintaining ambient chamber conditions, however it was generally believed that the diffusive flux component of organic compounds are not dependant on dissolved oxygen levels. Test results were not anticipated to be affected by the use of compressed air.

At the site near the quay wall the crane was positioned with its lift lines measured to allow placement of the BFSD2 at the desired location. An electrical extension cord was connected to a nearby building to provide power for the various deployment equipment (laptop computer, TV monitor and cabling) located in the trunk of the rental car (Figure 59). Preparations for the deployment followed a standard pre-deployment checklist (Figure 60).

Figure 59. Deployment Equipment.

Figure 60. Pre-Deployment Checklist.

After the BFSD2 was lowered to within view of the sediment surface it was established that no obstructions to chamber penetration were present and the decision to deploy was made. The crane lowered the BFSD2 at its maximum descent rate and a good landing was observed with the underwater video monitor. The bottom landing created a minimal amount of sediment resuspension and the water cleared within 15 seconds.

After video confirmation of sufficient sediment penetration to achieve a sea l the 10minute sensor check program was initiated. This program activated closure of the chamber lid which, while closing, simultaneously opened a hinge-mounted valve to collect the ambient-condition water sample (bottle #1). Following lid closure and activation of the recirculation subsystem, measurements of the enclosed water for dissolved oxygen, pH, temperature, pressure and salinity were made and recorded at 6second intervals for 10 minutes. Following completion of the 10-minute program t he sensor data was uploaded, processed and entered into a custom data template to confirm sensor functions and to establish initial ambient water conditions. The measurement for ambient dissolved oxygen was used to establish limits for the BFSD2 oxygen control subsystem. These values were entered into the 72-hour flux test program and downloaded to the submerged BFSD2. The limits selected reflected the use of compressed air in place of pure oxygen and allowed a near anoxic lower threshold to be reached before activating the oxygen (i.e. air) recharge valve. Figure 61 shows the ambient dissolved oxygen measurement with the upper and lower control limits superimposed and Figure 62 shows the ambient pH measurement.

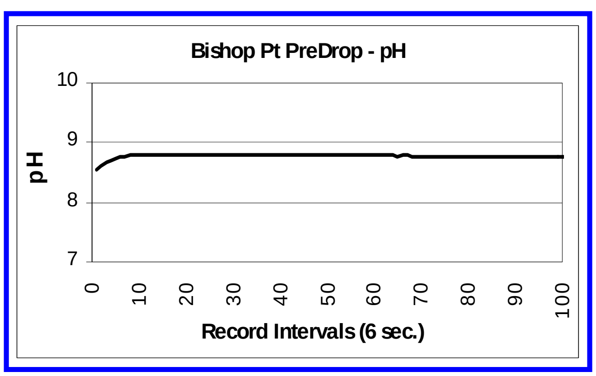


Figure 61. Ambient Dissolved Oxygen.

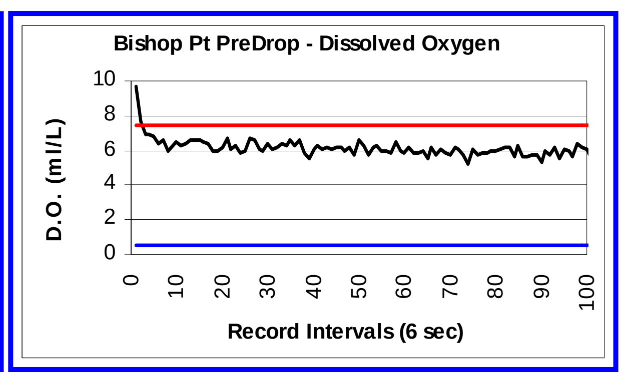


Figure 62. Ambient pH.

With the BFSD2 in place on the bottom, the downloaded 72-hour flux test program with the selected control limits was verified and the program was started. The BFSD2 connections were maintained to monitor and confirm collection of the first chamber sample (bottle #2) and sensor measurement recordings at 6-minute intervals. The crane tackle block was then disengaged from the deployment line and the crane was moved from the area. The deployment line and communication cables were stowed on the pier pilings to facilitate recovery at the completion of the 72-hour flux test.

At the conclusion of the 72-hour time period the BFSD2 communication cable was reconnected to the laptop computer to verify completion of the flux test program and to upload the recorded sensor data. The crane was then repositioned, rigged for recovery and the BFSD2 was lifted off the bottom and onto shore. Once secure on land an initial inspection indicated no damage, all components were intact and all twelve sample bottles were full. From a floating platform positioned over the deployment site a hand-held GPS location record was made and a 250-ml sediment sample was collected. The samples were then removed and transported to the field lab facility for filter removal, lid installation, labeling and preparation for shipment to the Arthur D. Little (ADL) analytical laboratory in Cambridge, MA. The BFSD2 was flushed and cleaned with freshwater, the gel-cell batteries were recharged and the sample collection subsystem was purged with deionized water and dried with forced-air in preparation for the return shipment to SSC SD.

As the samples were being processed, the recorded data files for the 72-hour test were uploaded and entered into a standardized Excel spreadsheet template for data processing. The sensor data, plotted as time-series indicated a successful deployment. As can be seen in Figure 63, there was no sudden pH level shifts indicating loss of chamber seal. The slowly reducing trend for pH level was normal and is indicative of biological activity. The dissolved oxygen level, Figure 64, shows the expected steady decline and control system activation as the level dropped below the lower limit. The decline was temporarily reversed, most likely due to residual pure oxygen in the system, however the recharge was not maintained due to the low oxygen content of the compressed air and the chamber eventually fell below the lower limit and remained at a near anoxic level until the test was completed. It is also noted that the slope of the declining pH became approximately level as the chamber approached anoxic conditions, indicating reduced biological activity. Salinity, temperature and pressure were normal.

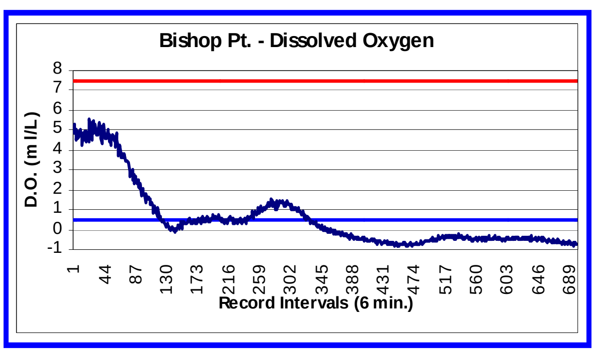


Figure 63. Chamber pH.

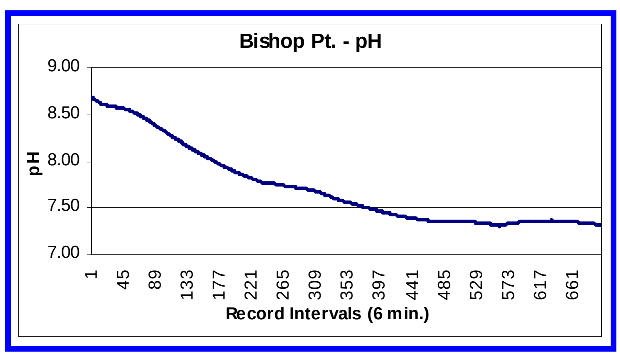


Figure 64. Chamber Dissolved Oxygen.

The samples were air-shipped from Honolulu International Airport by overnight express (FedEx) the afternoon of Sept 10, 2001. But the events of Sept 11, 2001 grounded all flights nation-wide and the samples were stopped and delayed in Oakland, CA until delivery to ADL on Sept 17, 2001. The samples were intact but exceeded the maximum extraction holding time (7 days) and maximum

storage temperature (4 degrees C.) when received. The conditions were noted and the decision to continue with processing and analysis was made.

5.1.6.1 Pearl Harbor Organics Demonstration Results.

Tables 14, 15 and 16 below provide a summary of the flux results for selected PAHs, PCB congeners and pesticides, respectively. Figures 65, 66, and 67 provide graphical comparison of the flux results with the blank tests results.

Table 14. Summary Results for PAHs.

PAH	Flux	+/- 95% C.L.	Flux rate Confidence	Triplicate Blank Flux ($ng/m^2/day$)		Bulk Sediment	Overlying Water
	($ng/m^2/day$)*	($ng/m^2/day$)	(%)	Average	+/- 95% C.L.	(ng/g)	(ng/L)
9. BENZO(A)ANTHRACENE	75.00	306.84	NA	NA	NA	16,000	Non-Detect
10. CHRYSENE	1048.91	1012.25	98.5%	23.94	22.32	48,000	5.1
11. BENZO(B)FLUORANTHENE	919.89	375.56	99.8%	-134.30	297.91	36,000	6.2
12. BENZO(K)FLUORANTHENE	234.99	156.43	93.3%	-9.71	36.30	10,000	2.5
13. BENZO(A)PYRENE	Non-Detect	NA	NA	NA	NA	12,000	Non-Detect
14. INDENO(1,2,3-C,D)PYRENE	6.72	67.06	NA	NA	NA	7,400	1.6
15. DIBENZ(A,H)ANTHRACENE	Non-Detect	NA	NA	NA	NA	1,500	1.5
16. BENZO(G,H,I)PERYLENE	7.91	64.14	11.6%	20.15	65.15	5,300	1.7

PAH	Flux	+/- 95% C.L.	Flux Rate Confidence	Triplicate Blank Flux ($ng/m^2/day$)		Bulk Sediment	Overlying Water
	($ng/m^2/day$)*	($ng/m^2/day$)	(%)	Average	+/- 95% C.L.	(ng/g)	(ng/L)
1. Naphthalene	-110.07	596.59	38.1%	-440.30	458.38	44	13
2. Acenaphthene	2680.41	10124.62	51.2%	-32.40	50.34	3,800	37
3. Acenaphthylene	627.85	1483.64	82.7%	208.47	112.60	1,200	5.6
4. Fluorene	75.17	1894.31	23.4%	-76.74	28.38	4,800	19
5. Phenanthrene	-552.72	1305.06	98.2%	10.95	10.95	54,000	32
6. Anthracene	4053.72	3094.52	100.0%	117.68	64.62	10,000	13
7. Fluoranthene	4435.81	10157.65	97.4%	-1423.95	178.41	270,000	52
8. Pyrene	38.99	4132.13	28.5%	-439.51	70.73	150,000	20

Table 15. Summary Results for PCBs.

PCB	Flux	+/- 95% C.L.	Flux rate Confidence	Blank Flux ($ng/m^2/day$)		Bulk Sediment	Overlying Water
	($ng/m^2/day$)*	($ng/m^2/day$)	(%)	Flux	+/- 95% C.L.	(ng/g)	(ng/L)
101 - 2,2',4,5,5'-Pentachlorobiphenyl	-2.62	93.70	4%	57.59	31.49	Non Detect	2.1

Table 16. Summary Results for Pesticides.

Pesticide	Flux	+/- 95% C.L.	Blank Flux ($ng/m^2/day$)		Bulk Sediment	Overlying Water
	($ng/m^2/day$)*	($ng/m^2/day$)	Flux	+/- 95% C.L.	(ng/g)	(ng/L)
Mirex	61.81	110.60	NA	NA	Non Detect	1.00

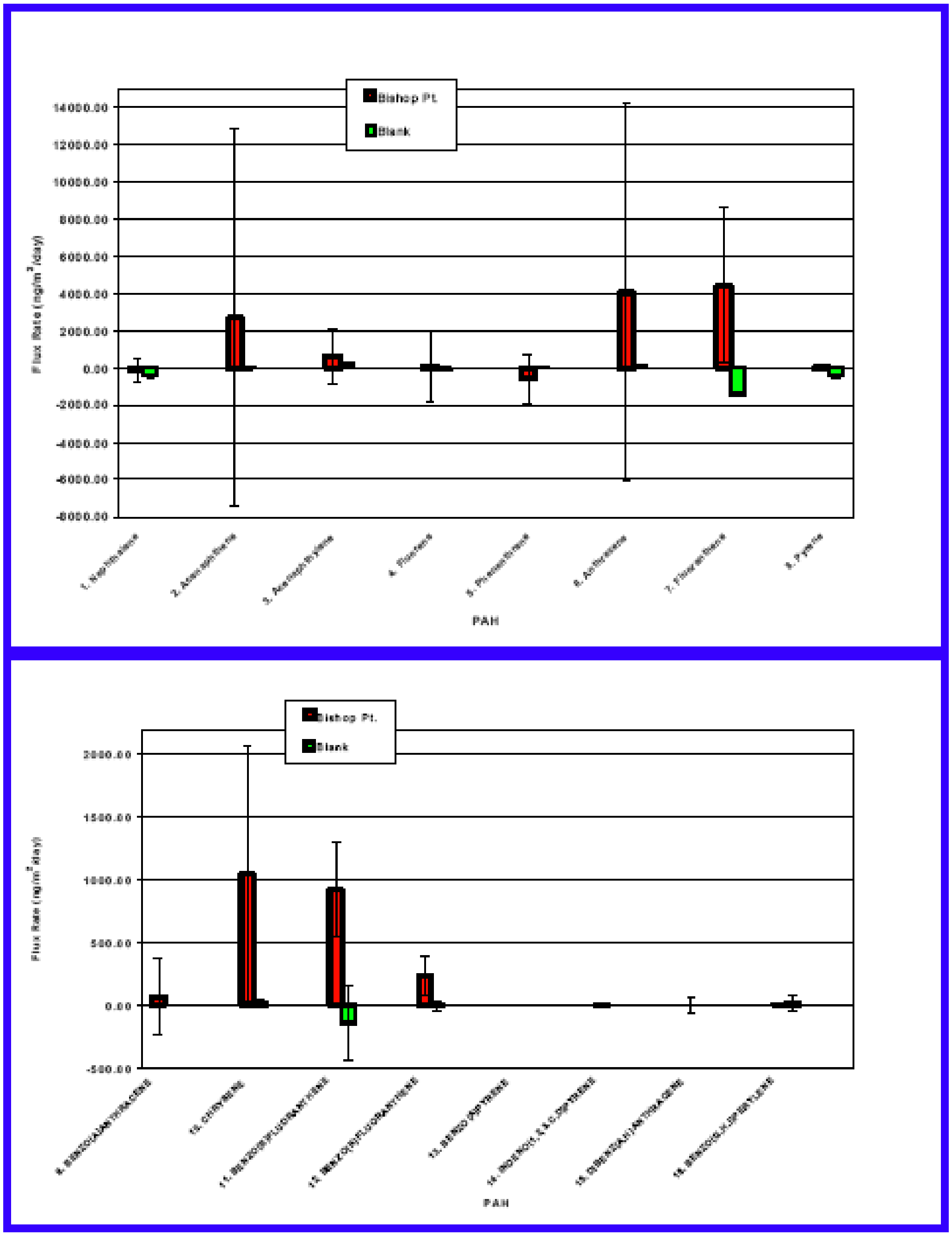


Figure 65. Flux to Blank Comparison for PAHs.

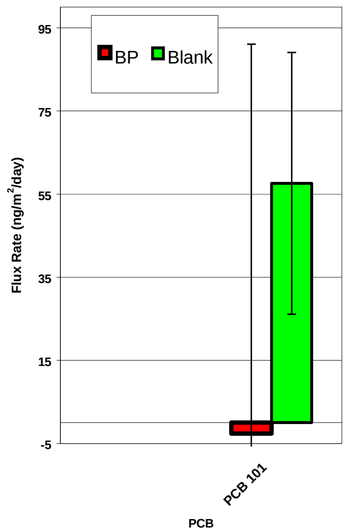


Figure 66. **Flux to Blank Comparison for PCBs.**

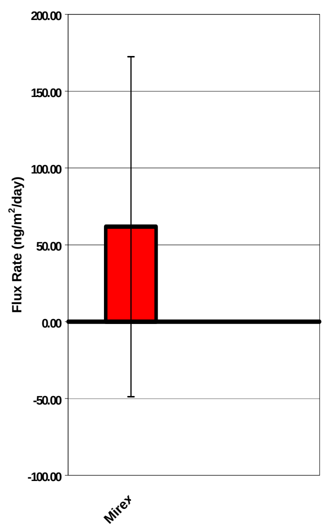


Figure 67. Flux to Blank Comparison for Pesticides.

5.1.6.1.1 Polynuclear Aromatic Hydrocarbons (PAHs) Results

Complete individual data sets were obtained for all of the first eight lighter molecular weight PAHs (Naphthalene, Acenaphthene, Acenaphthylene, Fluorene, Phenanthrene, Anthracene, Fluoranthene and Pyrene). Complete individual data sets were also obtained for five of the eight heavier molecular weight PAHs (Chrysene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Indeno(1,2,3-c,d)pyrene and Benzo(g,h,I)perylene). Partial data sets were obtained for Benzo[a]anthracene (9 of 12 detects) and Dibenzo[a,h]anthracene (4 of 12 detected). No detects were obtained for Benzo[a]pyrene. Flux analysis was accomplished for all complete data sets and the partial data set for Benzo[a]anthracene. However, the Benzo[a]anthracene analysis was abandoned since two of the

three non-detects occurred in the first four samples, as discussed below, and was compounded by a lack of blank test data for statistical comparison.

All trends in concentration change (i.e. flux) were strongly positive for the first four samples in each series of twelve. R^2 linearity factors for these initial trends were exceptionally high for all except Phenanthrene, Indeno(1,2,3-c,d)pyrene and Benzo(g,h,I)perylene. The concentration trends for the last eight samples in each series were generally flat or slightly negative with only Benzo(k)fluoranthene maintaining a lowered, but steady increase. R^2 linearity factors for these trends were correspondingly low. Due to this apparent change in concentration trends occurring after sample number four, coincident with the chamber dissolved oxygen level falling below the control limit at about 15 hours, separate analyses of the first four samples in each series and for the last eight samples in each series were accomplished. Also supporting this approach, the bulk sediment concentration levels for all the analyzed PAHs was directly related to the flux of the first four samples in the series and not for the last eight. And, whereas the relationship between bulk sediment concentrations and overlying water concentrations (measured in the number one sample) appear to be consistent with the solubility relationships discussed in the BFSD Paleta Creek demonstration report, the trend relationships identified for flux, bulk sediment concentrations and solubility appear to hold only for the first four samples. Table 17 shows these relationships for the first four PAH samples and Figure 68 shows the graphical comparison of the measured flux with the blank tests for the first four PAH samples.

Table 17. Summary Results for First Four PAH Samples.

PAH	Flux	+/- 95% C.L.	Flux Rate Confidence	Triplicate Blank Flux ($ng/m^2/day$)		Bulk Sediment	Overlying Water
	($ng/m^2/day$)*	($ng/m^2/day$)	(%)	Average	+/- 95% C.L.	(ng/g)	(ng/L)
1. Naphthalene	1,848	4,406	59.1%	-440.30	458.38	44	13
2. Acenaphthene	71,053	327,574	100.0%	-32.40	50.34	3,800	37
3. Acenaphthylene	6,862	14,388	100.0%	208.47	112.60	1,200	5.6
4. Fluorene	10,387	110,972	100.0%	-76.74	28.38	4,800	19
5. Phenanthrene	3,031	106,689	99.4%	10.95	10.95	54,000	32
6. Anthracene	26,955	27,293	100.0%	117.68	64.62	10,000	13
7. Fluoranthene	69,812	380,980	100.0%	-1423.95	178.41	270,000	52
8. Pyrene	24,512	190,722	100.0%	-439.51	70.73	150,000	20

PAH	Flux	+/- 95% C.L.	Flux rate Confidence	Triplicate Blank Flux ($ng/m^2/day$)		Bulk Sediment	Overlying Water
	($ng/m^2/day$)*	($ng/m^2/day$)	(%)	Average	+/- 95% C.L.	(ng/g)	(ng/L)
9. BENZO(A)ANTHRACENE	Non-Detect	NA	NA	NA	NA	16000	Non-Detect
10. CHRYSENE	8792.74	10650.17	100.0%	23.94	22.32	48000	5.1
11. BENZO(B)FLUORANTHENE	3080.74	17862.21	99.4%	-134.30	297.91	36000	6.2
12. BENZO(K)FLUORANTHENE	977.52	3135.53	99.7%	-9.71	36.30	10000	2.5
13. BENZO(A)PYRENE	Non-Detect	NA	NA	NA	NA	12000	Non-Detect
14. INDENO(1,2,3-C,D)PYRENE	122.97	7141.99	NA	NA	NA	7400	1.6
15. DIBENZ(A,H)ANTHRACENE	Non-Detect	NA	NA	NA	NA	1500	1.5
16. BENZO(G,H,I)PERYLENE	33.19	5249.47	7.0%	20.15	55.15	5300	1.7

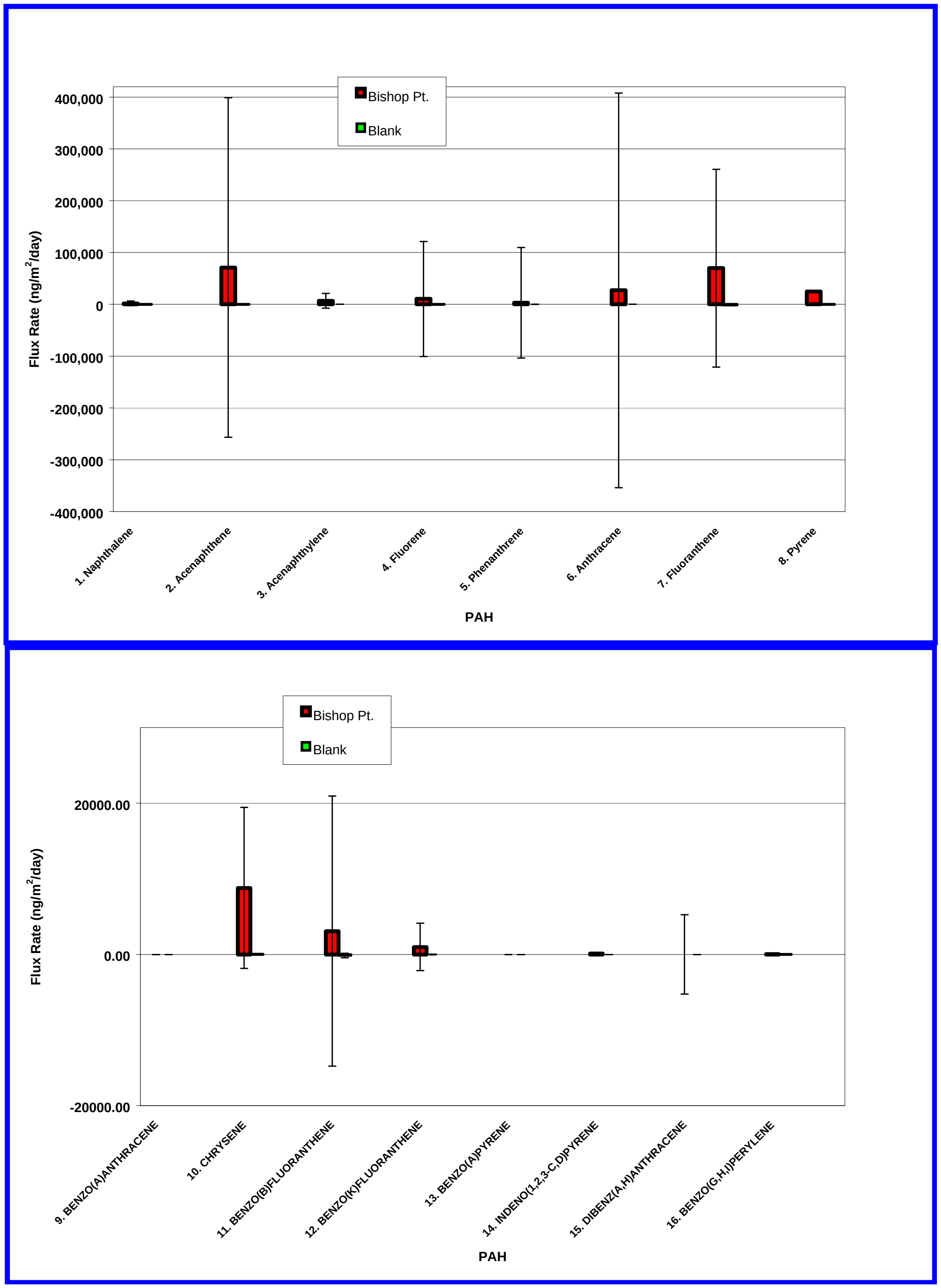


Figure 68. Flux to Blank Comparison for First Four PAH Samples.

The concentration trend (or flux) for the first four samples in the series, when compared to the statistically derived triplicate blank test trends showed large, significant flux for all of the eight lighter molecular weight PAHs. For seven of these eight PAHs the confidence that the flux was statistically different than the associated blank results was approximately 100%. The confidence for Naphthalene was 59.1%. For the five heavier molecular weight PAHs with complete data sets, the first four samples for Chrysene, Benzo(b)fluoranthene and Benzo(k)fluoranthene had high confidence (approximately 100%); Benzo(g,h,I)perylene had low confidence (7.0%); and

Indeno(1,2,3-c,d)pyrene had insufficient blank test data for comparison. For all the analyzed PAHs except Anthracene of the lighter molecular weight PAHs, and Benzo[b]fluoranthene and Benzo[k]fluoranthene of the heavier molecular weight PAHs, the last eight samples in the series exhibited concentration trends with low and/or negative trends as well as low confidence levels when compared to blank test results. Appendix D ("BP Organics Demo-PAHs.xls") includes time-series graphs showing flux and blank tests concentrations over time for the PAHs. Graphs for the complete data sets (12 samples), for the first four samples and for the last eight samples allow comparison of the flux and blank test results.

5.1.6.1.2 Polychlorinated Biphenyl (PCB) Congeners Results

One complete individual data set was obtained for PCB Congener number 101 (2,2',3,4,4',5,5'-Heptachlorobiphenyl). Partial data sets were obtained for ten PCB Congeners: number 8 (2,4'-Dichlorobiphenyl) with 2 of 12 detections; number 44 (2,2',3,5'-Tetrachlorobiphenyl) with 5 of 12 detections; number 52 (2,2',5,5'-Tetrachlorobiphenyl) with 5 of 12 detections; number 66 (2,3',4,4'-Tetrachlorobiphenyl) with 2 of 12 detections; number 105 (2,3,3',4,4'-Pentachlorobiphenyl) with 5 of 12 detections; number 118 (2,3',4,4',5-Pentachlorobiphenyl) with 1 of 12 detections; number 153 (2,2',4,4',5,5'-Hexachlorobiphenyl) with 1 of 12 detections; number 180 (2,2',3,4,4',5,5'-Heptachlorobiphenyl) with 7 of 12 detections; number 206 (2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl) with 4 of 12 detections; and number 209 (2,2',3,3',4,4',5,5',6,6'-Decachlorobiphenyl) with 1 of 12 detections. The remaining nine targeted PCB Congeners were not detected in the samples.

Flux analysis is reported for PCB Congener number 101 only, including statistical comparison with blank test data. The flux was small compared to the blank and it was negative (i.e. uptake). The 95% confidence limit values for the computed flux were large and the statistical confidence that the flux value was different than the corresponding blank was very small (4%). PCB Congener number 101 was not detected in the bulk sediment sample. The high flux rate trend noted in the first four samples for PAHs, prior to anoxic chamber conditions, was not evident for PCB Congener number 101 and separate analysis was not undertaken. Appendix D ("BP Organics Demo-PCBs.xls") includes a time-series graph showing flux and blank tests concentrations over time for PCB Congener number 101.

Flux analysis for the remaining PCBs having partial data sets was abandoned due to the degree of incomplete data and/or large intervals between data. Also, none of the PCB congeners with detections in seawater were reported in the bulk sediment analysis results.

5.1.6.1.3 Pesticides

Partial data sets were obtained for six pesticides: 2,4'-DDT with 1 of 12 detections; 4,4'-DDT with 3 of 12 detections; 4,4'-DDD with 4 of 12 detections; Dieldrin with 1 of 12 detections; Endrin with 7 of 12 detections; Mirex with 10 of 12 detections. The remaining ten targeted pesticides were not detected in the samples.

Flux analysis was accomplished for the pesticide Mirex only. No blank test results were available for this pesticide and therefore statistical comparison cannot be made. The computed flux value for Mirex was small with large 95% confidence limit values. Mirex was also not detected in the bulk sediment sample. The high flux rate trend noted in the first four samples for PAHs, prior to anoxic chamber conditions, was not evident for Mirex and separate analysis was not undertaken. Appendix A, Excel spreadsheets(.xls"), includes a time-series graph showing flux and blank tests concentrations over time for the pesticide Mirex.

Flux analysis for the remaining pesticides having partial data sets was not accomplished due to the degree of incomplete data and/or large intervals between data. And again, none were reported in the bulk sediment analysis results.

5.1.6.2 Discussion of Bishop Point Organics Results

Prior to data reduction and analysis, close inspection of the analytical laboratory results indicated a change or "knee" in sample concentration trends occurring after sample four for most PAHs, coincident with the dissolved oxygen level falling below control limits. The same change was not evident for the PCBs or pesticides, however the preponderance of "non detect" concentration levels in the seawater samples coincident with like results in the bulk sediment sample resulted in sufficient seawater data for only one PCB congener and one pesticide flux analysis. The PAHs on the other hand exhibited very large concentrations in the bulk sediment sample and 13 of sixteen yielded sufficient data for flux analysis. After correction for dilution and normalization for comparison to the blank tests the shift in concentration trends became even more evident for the PAHs and remained obscured by low concentration levels for the PCBs and pesticides. Thus separating the data sets into pre- and post-anoxic conditions for analysis allowed the affect of the low oxygen conditions on the PAH flux rates to be isolated to the last eight samples. The mechanism for this observed damping or stopping of the release of PAHs from the sediment is not known but may be related to reduction-oxidation chemistry changes causing soluble metals to precipitate and bind with organic compounds releasing from the sediment. Another possible explanation for the observed flux change may be loss of the irrigation component of the flux due to oxygen deprivation of the infaunal micro-organisms. Whatever the mechanism, it is clear that the large PAH concentrations in the sediment are the source of large flux levels entering the water column, albeit evidenced by only the first four samples. It is also clear that maintenance of at least a minimum level of dissolved oxygen (approximately 1.0 ml/L) in the chamber is required to achieve complete flux results for the full duration of the test. As a result of using compressed air in place of pure oxygen for maintenance of the chamber dissolved oxygen conditions, only the four samples collected during the first 14 hours of the test are considered valid for analysis. Of these four, only the last three were collected from the chamber at time intervals of 7 hours and thus the full value of the 12-sample, 70-hour test was not achieved. However, minimum statistical standards are met with the four samples and the following discussion and conclusions derived from them are considered valid.

As found in the Paleta Creek demonstration, the flux results for the lighter molecular weight PAHs indicate greater mobility from the sediment into the overlying water than the heavier compounds. Of interest is the measured concentration of the PAHs in the bulk sediment sample being higher for the mid-molecular weight compounds than for the lighter or the heavier compounds. This distribution of sediment concentrations resulting from the industrial and operational activity at the site, led to high flux levels for even the less soluble heavier molecular weight PAHs compared to the lighter molecular weight PAHs. Notwithstanding this result, it appears that the heavier molecular weight PAHs are significantly less mobile, even with higher concentrations in the bulk sediment, than the lighter compounds. For example, the flux value for Acenaphthene (molecular weight-154) was about the same as Fluoranthene (molecular weight-202), but the bulk sediment concentration is about 1.4% that of Fluoranthene. And, as before, comparison of this finding with solubility measurements of the targeted PAHs in seawater shows the same trend: the heavier molecular weight PAHs are far less soluble. In the example above, Acenaphthene is approximately 16.6 times more soluble than Fluoranthene. Thus even a low mobility, heavier molecular weight PAH with a high enough concentration in the sediment may flux into the overlying water at a higher rate than a lighter compound at lower concentrations.

Based on molecular weight and solubility, the above discussion also generally applies to PCBs and pesticides, i.e. their mobility as indicated by the flux results will be generally in direct proportion to solubility and in inverse proportion to molecular weight. This premise cannot be supported by the results of this demonstration due to the very low concentration levels of the PCBs and pesticides in the sediment. The one PCB and one pesticide detected with sufficient data to allow analysis yielded results with low confidence and no conclusions can be drawn from either the full set of data or the first four samples. It does appear however that both PCBs and pesticides are not a water quality issue for this site.

5.1.6.3 Conclusions for Bishop Point Organics Demonstration Test

The BFSD2 demonstration at Bishop Point, Pearl Harbor was a qualified success. A single factor, use of compressed air in place of pure oxygen for chamber dissolved oxygen maintenance, was responsible for loss of valid data after approximately 14 hours into the 72-hour test. The affect of anoxic level conditions to stop, reduce or interfere with the release of organic compounds from contaminated sediment, previously not anticipated, was established. And, prior to this affect occurring, valid data was obtained.

The results from the first 14 hours of the 72-hour test show that measurement of the mobility of organic compounds from the highly contaminated sediments at the Bishop Point site within the Pearl Harbor Naval Complex was successfully achieved. The measurements, when compared to triplicate blank test results resulted in quantification of large, statistically significant values with high confidence for Polynuclear Aromatic Hydrocarbons (PAHs) fluxing into overlying water. Complete data sets for nearly all of the targeted US EPA priority PAHs were achieved and the flux results are consistent with bulk sediment concentrations, modified by the relative solubility of the compounds. Polychlorinated Biphenyl (PCB) Congeners and pesticides were not measured either because they were not present or because they were below analytical detection limits.

Ideally, a repeat of this test should be conducted to resolve potential questions regarding oxygen control during the measurement of organic contaminant fluxes. It could be conducted at the Bishop Point site or any other site where high levels of targeted organic compounds are present in the sediment. Whereas the first demonstration at Paleta Creek established the capability of the BFSD2 and the related data analysis process to extract meaningful results at a site with moderate levels of contaminants in the sediments, this demonstration only partially established the BFSD2 performance at a site with high levels of organic contaminants in the sediment. A full 72-hour test at such a site would help to demonstrate and establish BFSD2 performance as concentration levels become very large in a high flux level condition. However, even in lieu of this additional testing, it is clear that the BFSD2 can statistically resolve fluxes for a number of organic contaminants even when the number of samples is limited.

5.1.7 Pearl Harbor, Bishop Point, Combined Demonstration

One 72-hour test was conducted to demonstrate the ability of the Benthic Flux Sampling Device 2 to collect samples for both metals and PAH analysis in a single deployment. The The MUDSU-1 facility at Bishop Point, Pearl Harbor, Hawaii was selected because both a metals deployment and a deployment for PAH’s were made in the area. The combined demonstration was successfully conducted on December 9-12, 2002. A previous attempt was made in October of 2003, but because of a technical malfunction and issues with the electronic control unit of the BFSD2, that deployment was unsuccessful.

The combined demo followed the metals demonstration by 3 years and 10 months and the PAH demonstration by 1 year and 3 months. Although all the deployments were made along the quay wall at the MUDSU-1 facility, deployment logistics made it impossible to sample the exact spot in all three deployments. Hence, the combined demo position was 20 meters west of the metals deployment and 34 meters east of the PAH deployment (Figure 69). These distances should not be significant in comparing overall operation of the BFSD between deployments at a general site, but some patchy contamination of sediments may be exhibited in the results with some contaminants. Also, the difference in time between deployments could conceivably show some variability in results.

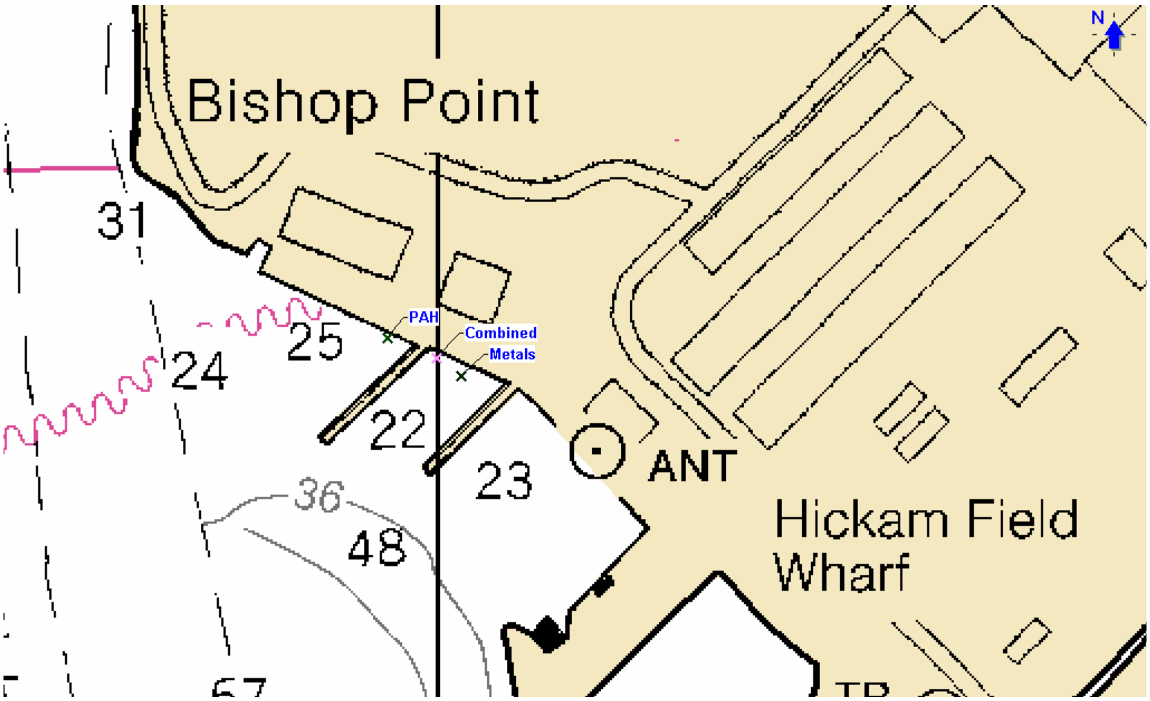
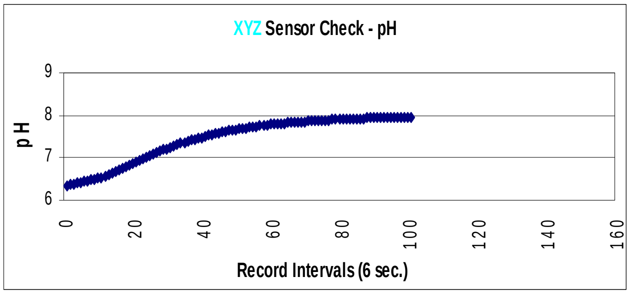


Figure 69. Pearl Harbor, Bishop Point Demonstration Locations.

The preparation and deployment for the combined demo followed very closely the procedures and events of the previous PAH demonstration deployment. The BFSD2 was cleaned, packed and shipped from SSC San Diego. When unpacked at Pearl Harbor, all systems were assembled, inspected and checked. The oxygen bottle was filled with O_2, and no problem with oxygen limitations was anticipated or encountered during the deployment as it was with the PAH deployment.

The BFSD2 was lowered into the water with a crane along the quay wall, and a pre- deployment checklist was followed. After the bottom was scanned with the onboard video camera and determined to be appropriate, the BFSD2 was landed and pre-deployment measurements taken. After the 10-minute pretest, sensors had stabilized and an oxygen range to be maintained could then be programmed for the 72-hour test from values taken during the pretest (Fig. 70). The 72-hour test was then started. Cables leading from the BFSD were disconnected from power, computers and video monitors and, together with a recovery line, were coiled and stored along the quay wall.



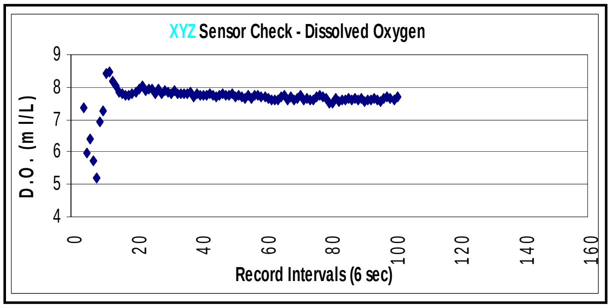
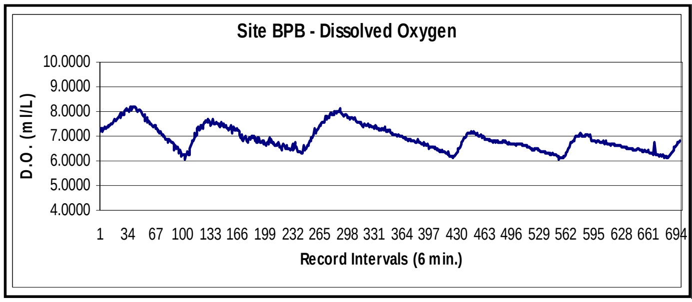


Figure 70. Pearl Harbor, Bishop Point Combined Metals Pre-Deployment Sensor Graphs.

Occasionally during the test, the cables were reconnected to the computer and video monitor and status was determined. All appeared normal during these checks and the cables resecured.

After 72 hours, the test was halted. Before the BFSD2 was raised from the bottom, data were uploaded via the stored cables on the quay wall. The BFSD2 was then raised from the bottom with the crane and deposited on the pier. The 24 sample bottles were briefly checked and found to be all full. They were then washed down, disconnected and removed from their racks. Samples were then taken to the field lab where filters were removed, labels added and they were shipped to Battelle labs for analysis.

Logged data were entered into Excel spreadsheets templates for processing. Oxygen and pH data show the deployment was successful in maintaining a tight seal and maintenance of the flux chamber integrity. Figure 71 shows a steady decline in pH which indicates no loss of seal or sudden contamination from outside the chamber. Figure 71 also shows the chamber was maintained oxic with the assistance of the O_2 feedback and injection system.



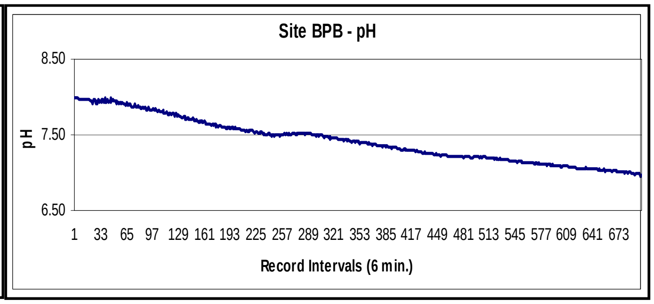


Figure 71. Pearl Harbor, Bishop Point Combined Metals Full Test Sensor Graphs.

5.1.7.1 Pearl Harbor Combined Demonstration Results

Table 18 gives a summary of the flux results for metals and Figure 72 show these in graphical form. Flux of dissolved oxygen from the chamber, or the oxygen demand of the sediments, is also given in Table 18. This was calculated from the O_2 data logged from the chamber during the first decreasing slope in the 72-hour test before the O_2 feedback injection system raised the O_2 level.

Metals behaved similarly in this combined demonstration as they did in the original metals demonstration at the Bishop Point Site except for copper (Figure 73). Cadmium, lead, nickel, manganese and zinc all fluxed out of the sediments, a trend which is consistent with previous work,

while copper was adsorbed by the sediment. Copper fluxed out of the sediments during the initial study. Manganese behaved similarly in both studies in that it exhibited a higher flux rate during the first three samples of the test then leveled off for the remainder of the test period. This trend with Manganese is discussed in the Paleta Creek discussion section 5.1.3.1. Flux rates for manganese for the first 14 hours of the test as well as for the entire test are presented here. In general, flux rates were higher during this combined demonstration than during the metals-only demonstration.

PAH flux results are presented in two ways. First, the entire 72-hour test results with all twelve samples are presented. These data are presented in Figures 74 and 75 and Table 19. Then, secondly, results from the first four samples of the test, those up to 21.3 hours into the test, are shown. This is for comparison to the original organics-only demonstration where flux rates showed an initial slope then plateaued. In the original test, oxygen depletion in the chamber was theorized as the cause for this plateau, but oxygen levels were successfully maintained in the chamber during the second test. For whatever reasons this plateauing occurs, the trend seemed to repeat itself during the combined demonstration. For comparison purposes, the "first four" data are used to calculate flux rates.

Table 18. Pearl Harbor, Bishop Point Combined Metals Summary of Metals.

Metal	Flux	+/- 95% C.L.	Flux rate Confidence	Triplicate Blank Flux (□g/m^2/day)	
	(□g/m^2/day)*	(□g/m^2/day)	(%)	Average	+/- 95% C.L.
Arsenic (As)	23.48	6.94	100%	-5.16	2.10
Copper (Cu)	-71.30	39.43	100.0%	2.82	8.73
Cadmium (Cd)	1.31	1.63	98.1%	-0.52	0.75
Lead (Pb)	17.40	24.63	99.0%	3.16	1.59
Nickel (Ni)	59.18	55.96	100.0%	10.28	7.34
Manganese (Mn)	427.65	238.42	100.0%	-264.85	7.49
Manganese (Mn)[1]	1940.13	3853.39	100.0%	-264.85	7.49
Silver (Ag)	-0.36	0.88	86.1%	0.64	0.68
Zinc (Zn)	374.36	133.74	100.0%	-3.38	65.22
Other					
Oxygen (O_2)* (*ml/m^2/day)	-1457.09	48.92	na	na	na
Silica (SiO_2)* (*mg/m^2/day)	0.00	0.00	48%	-1.97	2.88

1. Mn flux calculated on the first three samples due to non-linearity and to compare with metals-only demonstration

Flux rates for PAH's were similar in this combined test as it was in the original test. All PAH's that were measured fluxed out of the sediments except for phenanthrene. The largest flux rate measurement was for fluoranthene which also showed a large presence in the original test. This was followed by anthracene, acenaphthene and naphthalene, again similar to the original test. Similarities from the first test were also seen in the heavier molecular weight PAH's as benzo(a)pyrene,

benzo(k)flouranthene and chrysene showed large presence. Benzo(a)pyrene also showed a spike in this test but wasn't detected in the original test.

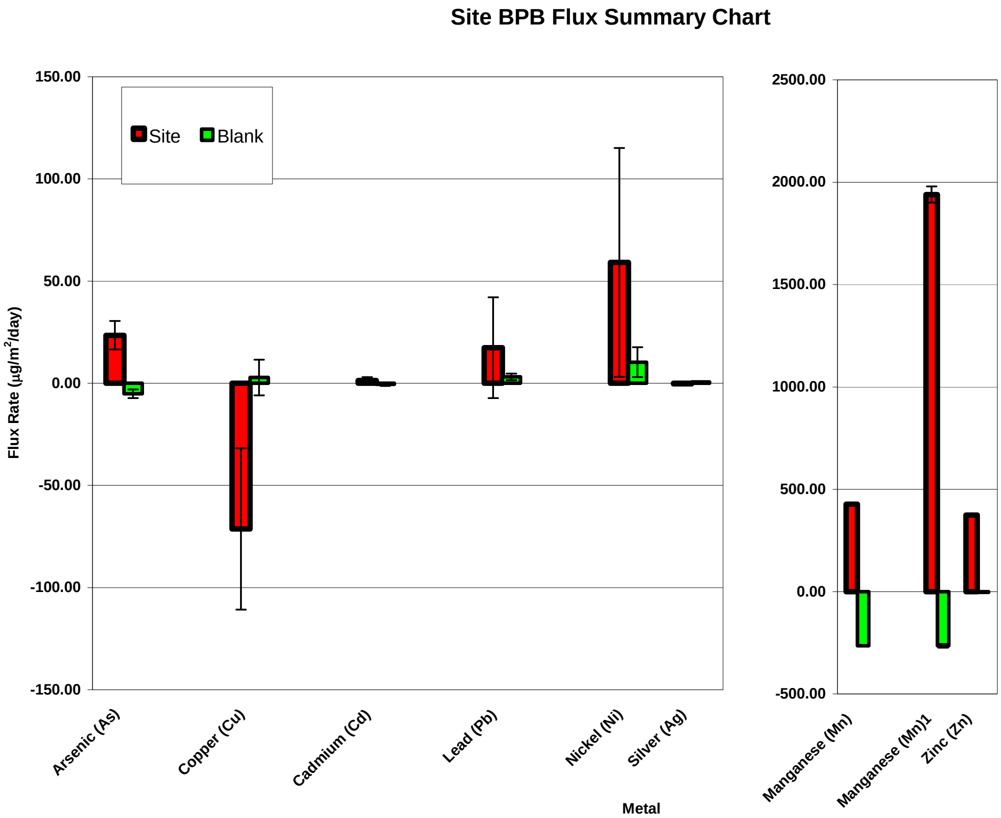


Figure 72. Pearl Harbor, Bishop Point Combined Metals Comparison of Flux and Blanks.

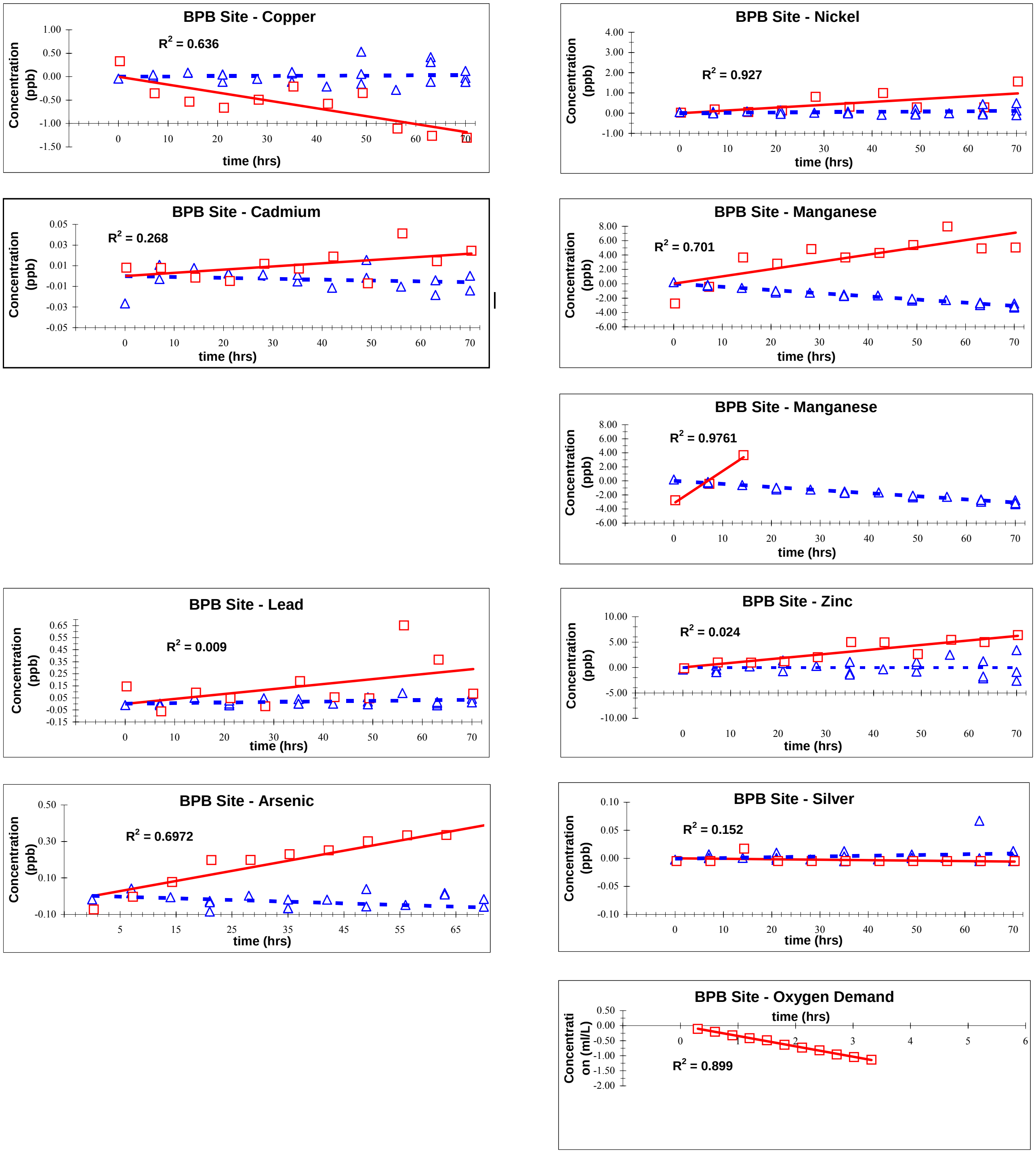
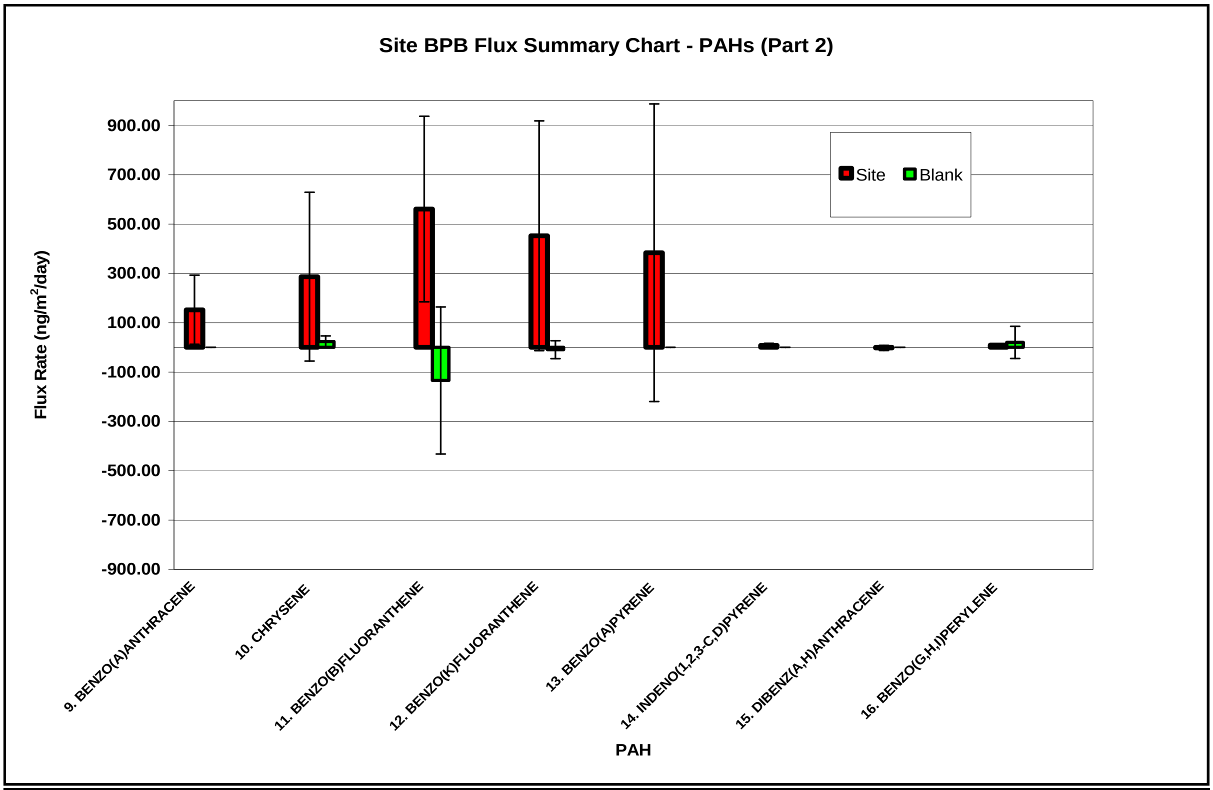


Figure 73. Pearl Harbor Bishop Point Combined Demonstration Metals Time Series Graphs.

Table 19. Pearl Harbor, Bishop Point Combined Demo Summary Results for PAH's (all samples**).**

PAH	Flux (ng/m^2/day)*	+/- 95% C.L. (ng/m^2/day)	Flux Rate Confidence (%)	Triplicate Blank Flux (ng/m^2/day) Average	Triplicate Blank Flux (ng/m^2/day) +/- 95% C.L.
1. Naphthalene	711.03	2352.17	92.8%	-440.30	458.38
2. Acenaphthene	-1387.81	1989.31	91.4%	-32.40	50.34
3. Acenaphthylene	106.66	213.64	31.9%	208.47	112.60
4. Fluorene	-359.38	256.56	100.0%	-76.74	28.38
5. Phenanthrene	-639.76	1228.00	99.6%	10.95	10.95
6. Anthracene	763.68	546.29	100.0%	117.68	64.62
7. Fluoranthene	2749.93	3651.35	100.0%	-1423.95	178.41
8. Pyrene	2191.62	2392.29	100.0%	-439.51	70.73
PAH	**Flux (ng/m^2/day)***	**+/- 95% C.L. (ng/m^2/day)**	**Flux rate Confidence (%)**	**Triplicate Blank Flux (ng/m^2/day) Average**	**Triplicate Blank Flux (ng/m^2/day) +/- 95% C.L.**
9. BENZO(A)ANTHRACENE	152.67	140.49	NA	NA	NA
10. CHRYSENE	286.65	341.92	94.7%	23.94	22.32
11. BENZO(B)FLUORANTHENE	561.07	376.08	97.9%	-134.30	297.91
12. BENZO(K)FLUORANTHENE	452.24	465.75	82.8%	-9.71	36.30
13. BENZO(A)PYRENE	383.46	603.38	NA	NA	NA
14. INDENO(1,2,3-C,D)PYRENE	8.68	10.98	NA	NA	NA
15. DIBENZ(A,H)ANTHRACENE	-1.97	7.69	NA	NA	NA
16. BENZO(G,H,I)PERYLENE	8.77	10.59	12.9%	20.15	65.15



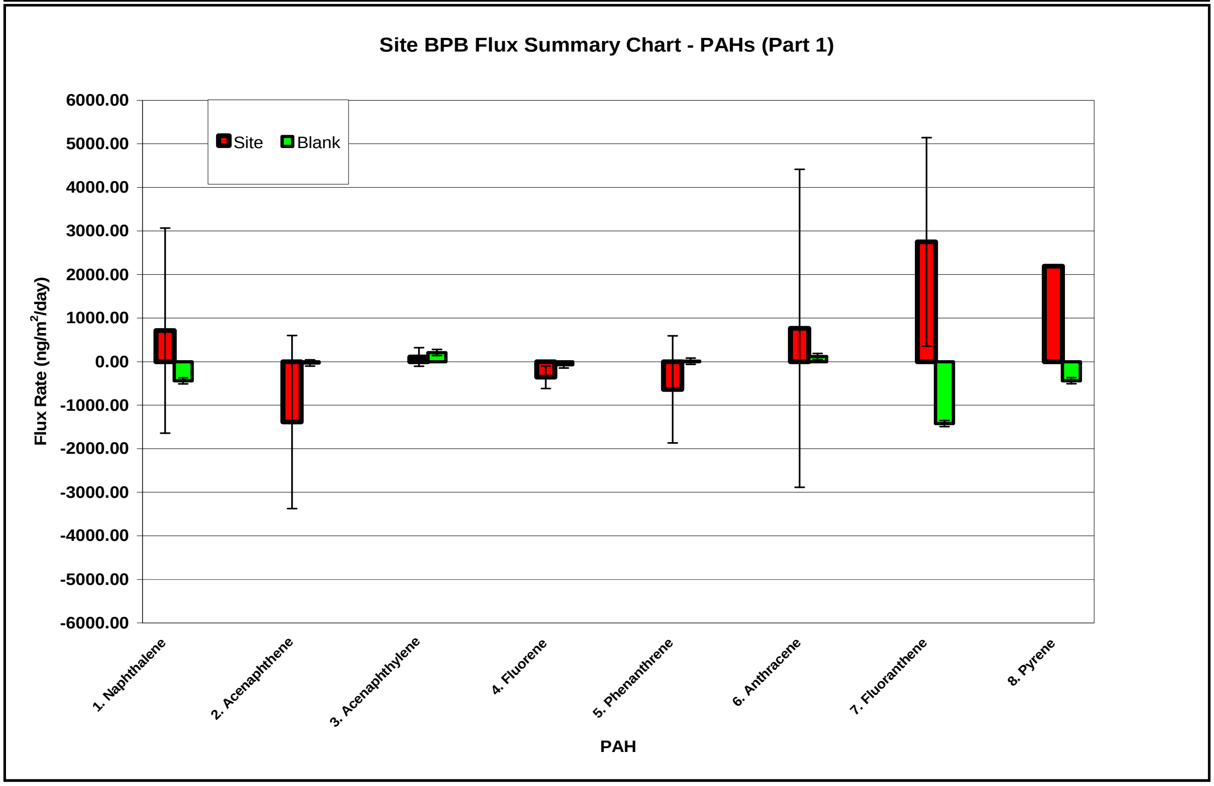


Figure 74. Pearl Harbor, Bishop Point Combined PAH Comparison of Flux to Blanks (all samples**).**

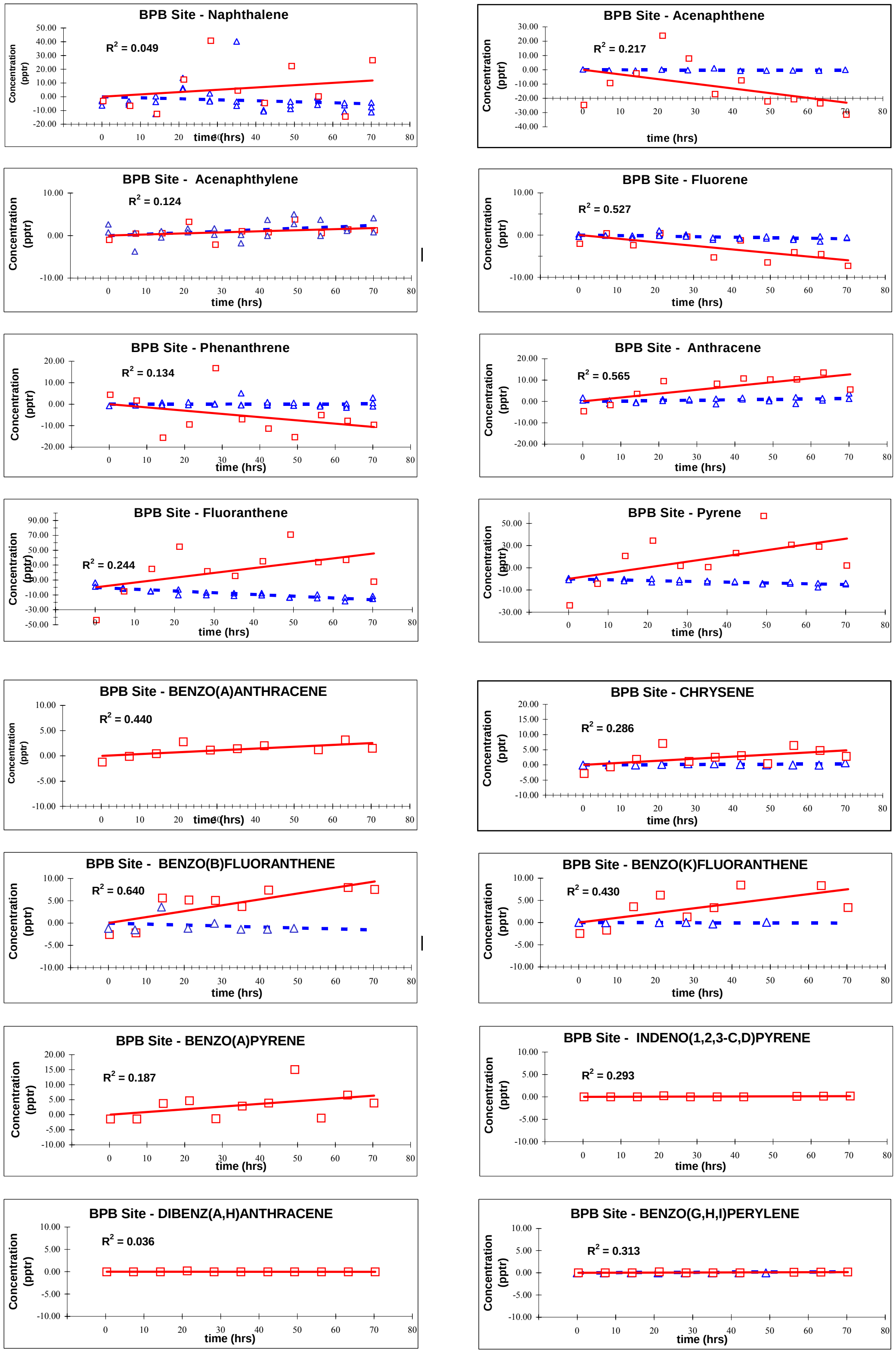
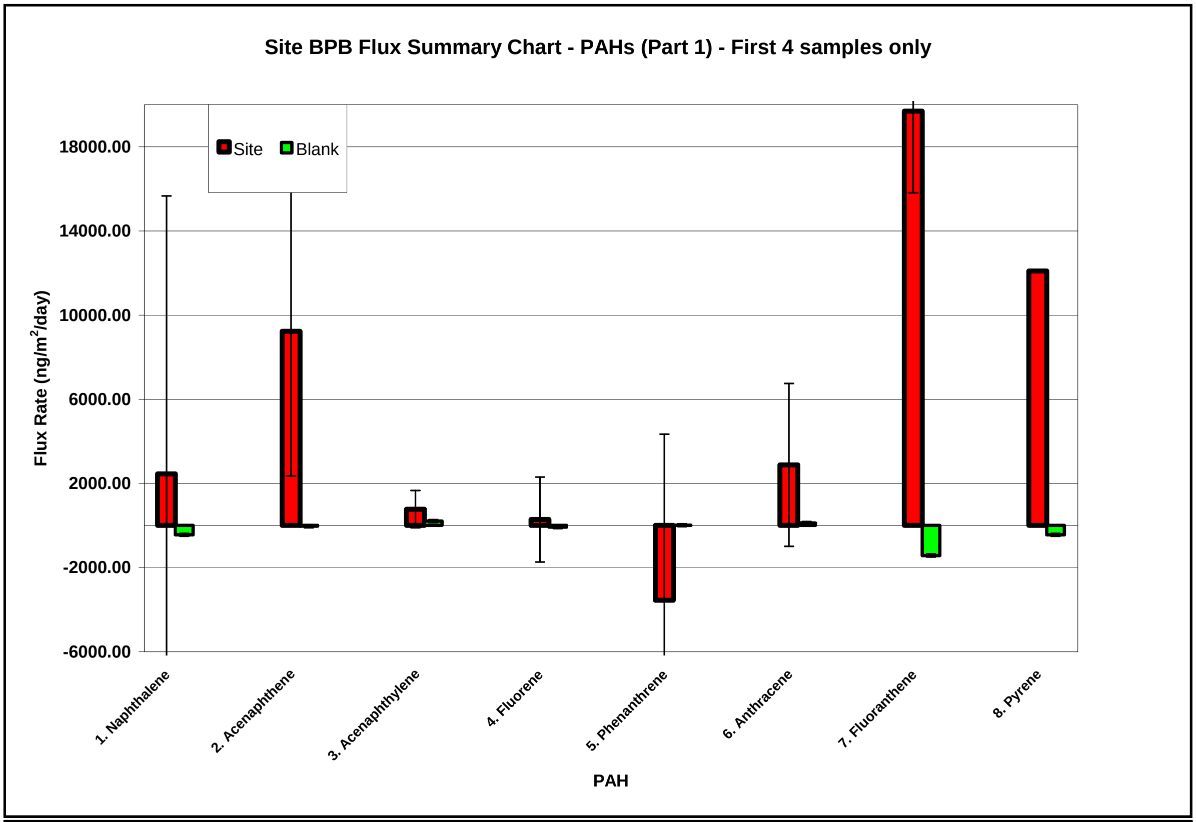


Figure 75. Pearl Harbor, Bishop Point Combined Demonstration PAH Time Series Graphs (all samples**).**

Table 20. Pearl Harbor, Bishop Point Combined Demo Summary Results for PAH's (First 4 samples**).**

PAH	Flux (ng/m2/day)*	+/- 95% C.L. (ng/m2/day)	Flux Rate Confidence (%)	Triplicate Blank Flux (ng/m2/day) Average	+/- 95% C.L.
1. Naphthalene	2456.72	13211.63	100.0%	-440.30	458.38
2. Acenaphthene	9222.27	6867.34	100.0%	-32.40	50.34
3. Acenaphthylene	778.37	880.29	100.0%	208.47	112.60
4. Fluorene	285.70	2021.66	100.0%	-76.74	28.38
5. Phenanthrene	-3555.98	7892.27	100.0%	10.95	10.95
6. Anthracene	2874.10	1330.22	100.0%	117.68	64.62
7. Fluoranthene	19696.65	3869.67	100.0%	-1423.95	178.41
8. Pyrene	12101.21	3884.64	100.0%	-439.51	70.73
PAH	Flux (ng/m2/day)*	+/- 95% C.L. (ng/m2/day)	Flux rate Confidence (%)	Triplicate Blank Flux (ng/m2/day) Average	+/- 95% C.L.
9. BENZO(A)ANTHRACI	760.90	668.14	NA	NA	NA
10. CHRYSENE	1949.20	1370.02	100.0%	23.94	22.32
11. BENZO(B)FLUORAN	1878.90	2921.78	100.0%	-134.30	297.91
12. BENZO(K)FLUORAN	1890.04	1526.34	100.0%	-9.71	36.30
13. BENZO(A)PYRENE	1413.41	1785.07	NA	NA	NA
14. INDENO(1,2,3-C,D)PY	41.71	103.62	NA	NA	NA
15. DIBENZ(A,H)ANTHR	34.46	85.60	NA	NA	NA
16. BENZO(G,H,I)PERYI	39.90	99.12	43.2%	20.15	65.15



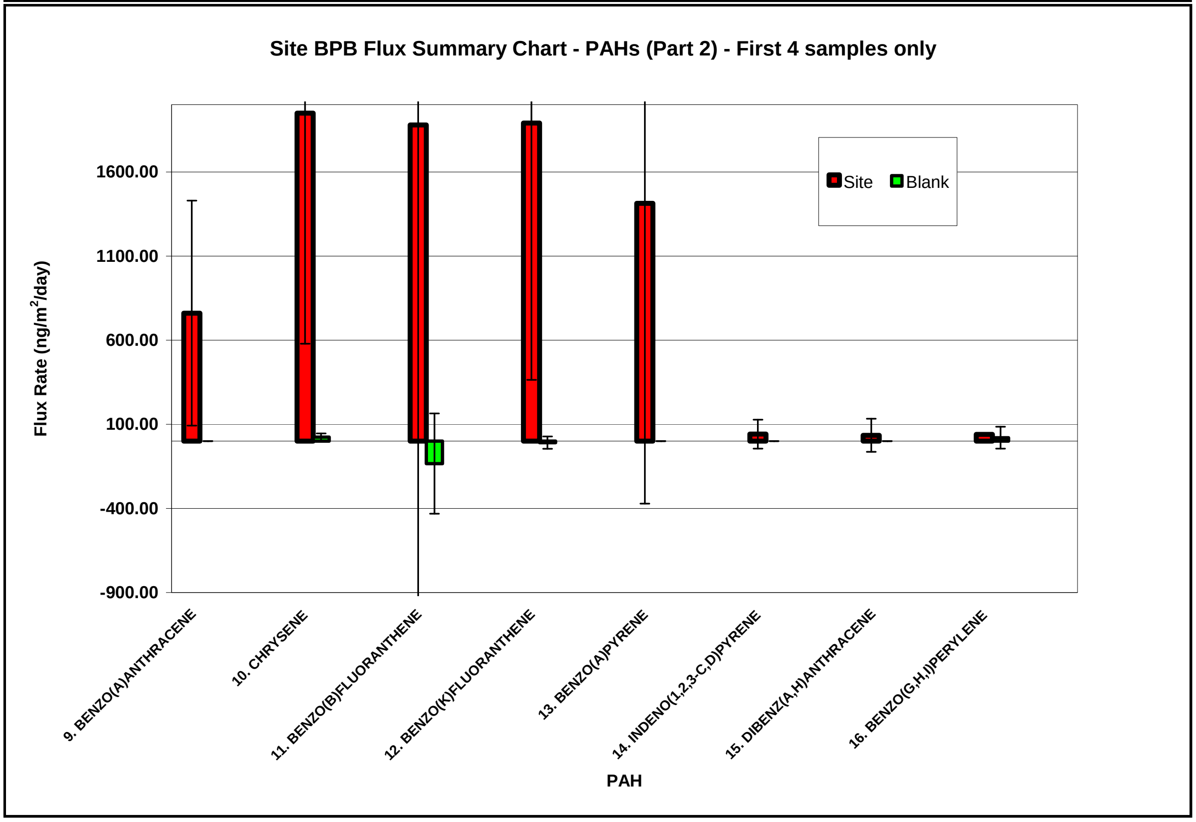


Figure 76. Pearl Harbor, Bishop Point Combined PAH Comparison of Flux to Blanks (First 4 samples**).**

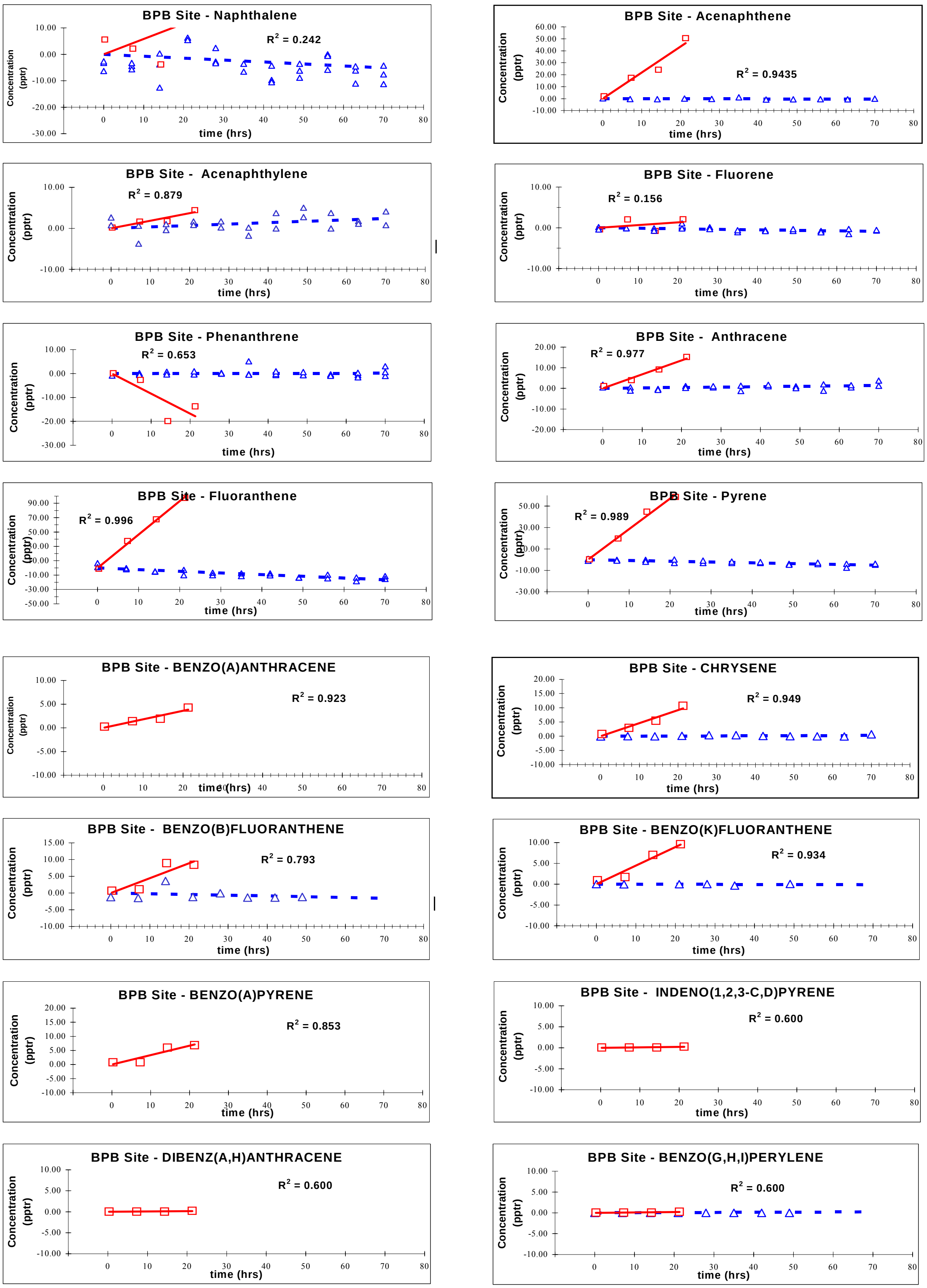


Figure 77. Pearl Harbor, Bishop Point Combined Demonstration PAH Time Series Graphs (First 4 samples**).**

5.1.7.2 Pearl Harbor Combined Demonstration Discussion

For the most part, flux rates for metals and organics behaved similarly at the Bishop Point sight for both the organics-only, metals-only and this combined demonstration of both organics and metals. Tables 21 and 22 show a side by side comparison of these demonstration flux results.

Table 21. Comparison of Flux Rates from Metals-only and Combined Demonstrations.

	Combined Demo		Metals Only Demo	
Metal	Flux (□g/m2/day)*	+/- 95% C.L. (□g/m2/day)	Flux (□g/m2/day)*	+/- 95% C.L. (□g/m2/day)
Arsenic (As)	23.48	6.94		
Copper (Cu)	-71.30	39.43	112.46	17.60
Cadmium (Cd)	1.31	1.63	1.85	1.96
Lead (Pb)	17.40	24.63	0.71	1.11
Nickel (Ni)	59.18	55.96	21.04	15.41
Manganese (Mn)	427.65	238.42	223.33	284.79
Manganese (Mn)1	1940.13	3853.39	2177.45	192.60
Silver (Ag)	-0.36	0.88		
Zinc (Zn)	374.36	133.74	191.18	54.07

Copper and zinc are the only metals which showed a significant difference between sampling during the first metals only demo and the combined demo. Copper actually showed a reverse trend during the second test. Zinc flux rate was higher during the combined demo than during the first. However, cadmium, lead, nickel and manganese showed similar trends and lay within the 95% confidence intervals of the calculated slopes. Arsenic and silver were not reported during the first test and could not be compared here.

Flux rates for PAH's were calculated for the first 4 samples taken in order to compare with the original Bishop Point organics test. Concentrations for PAH's for both tests evened out or plateaued after the fourth sample was collected at about 22 hours. The "first four" flux rates are probably more realistic as that was measured before any interference or interaction with natural, in-situ processes caused by the chamber itself. The only organic which was significantly different from the first test was Phenanthrene which showed a negative flux or and absorption into sediments during the combined demo. All other organic compounds measured during the first test showed similar flux rates when compared to the 95% confidence limits of the flux curves.

The cause for the organic concentrations leveling off is not immediately known. Low oxygen levels and anoxic conditions inside the chamber during the first test were blamed for the effect. However

adequate oxygen conditions were maintained during the second test with the same result. High bulk sediment concentrations measured at Bishop Point may suggest a loading or saturation of PAH's within the chamber after 22 hours which would result in a dampening of the flux processes.

Table 22. Comparison of Flux Rates from PAH-only and Combined Demonstration.

PAH	Combined Demo Flux (ng/m2/day)*	Combined Demo +/- 95% C.L. (ng/m2/day)	PAH Only Demo Flux (ng/m2/day)*	PAH Only Demo +/- 95% C.L. (ng/m2/day)
1. Naphthalene	2456.72	13211.63	1848.00	4406.00
2. Acenaphthene	9222.27	6867.34	71053.00	327574.00
3. Acenaphthylene	778.37	880.29	6862.00	14388.00
4. Fluorene	285.70	2021.66	10387.00	110972.00
5. Phenanthrene	-3555.98	7892.27	3031.00	106689.00
6. Anthracene	2874.10	1330.22	26955.00	27293.00
7. Fluoranthene	19696.65	3869.67	69812.00	380980.00
8. Pyrene	12101.21	3884.64	24512.00	190722.00
PAH	Flux (ng/m2/day)*	+/- 95% C.L. (ng/m2/day)	Flux (ng/m2/day)*	+/- 95% C.L. (ng/m2/day)
9. BENZO(A)ANTHRACENE	760.90	668.14	Non-Detect	NA
10. CHRYSENE	1949.20	1370.02	8792.74	10650.17
11. BENZO(B)FLUORANTHENE	1878.90	2921.78	3080.74	17862.21
12. BENZO(K)FLUORANTHENE	1890.04	1526.34	977.52	3135.53
13. BENZO(A)PYRENE	1413.41	1785.07	Non-Detect	NA
14. INDENO(1,2,3-C,D)PYRENE	41.71	103.62	122.97	7141.99
15. DIBENZ(A,H)ANTHRACENE	34.46	85.60	Non-Detect	NA
16. BENZO(G,H,I)PERYLENE	39.90	99.12	33.19	5249.47

5.1.8 Paleta Creek and Pearl Harbor Metals Demonstrations Data Assessment.

BFSD2 performance assurance indicators show that: (1) a proper seal was achieved during both sets of demonstration deployments and chamber isolation of test water was maintained; (2) oxygen levels were maintained close to ambient levels, and; (3) silica, oxygen and pH trends varied as expected.

It was concluded that the two sets of deployments of BFSD2 at Paleta Creek and at Pearl Harbor, Hawaii demonstrated consistent performance and the ability to measure trace metal mobility at distinctly different sites. Ease of operation and reliability were also demonstrated. It was further concluded that BFSD2 can provide accurate and repeatable measurements of the mobility of trace metal contaminants to and from shallow water marine sediments when certain prerequisite conditions

are met. These sediment flux rates can be established with high confidence when the routine procedures, standard methods and protocols demonstrated during this study are followed. The BFSD2 and its support equipment are mobile by air transport, field portable and can be operated with a minimum of resources. Comparison of measured sediment fluxes with blank-chamber fluxes provides a statistical benchmark for the significance of the measured flux rates. Where statistically significant fluxes are observed, evaluation of impacts on water quality can be carried out, or comparisons can be made to bioaccumulation measurements to help identify exposure pathways. The resulting analysis will provide a significant new tool in evaluating potential cleanup options at contaminated sediment sites.

5.1.9 Technology Comparison

There are no directly comparable technologies to the Benthic Flux Sampling Device for *in situ* contaminated sediment flux measurements. Current alternative approaches, such as bulk sediment analysis, have been discussed throughout this report. Alternate methods and associated costs are discussed in section 6.1.4. Site specific considerations must be considered in determining which combination of technologies will provide the best information. Data analysis and interpretation is likewise dependent on site specific considerations as illustrated in this report.

6. Cost Assessment

6.1 Cost Performance

The expected operational costs for the Benthic Flux Sampling Device 2 (BFSD2) are largely driven by analytical laboratory costs. Although typical analytical laboratory prices have shown reductions, the detection level required to achieve meaningful BFSD2 flux measurements requires specialized equipment and highly skilled technicians available at limited sources. Other BFSD2 expected operational costs are driven primarily by labor, supplies and transportation costs during the pre-operational, operational and post-operational phases of deployment. The combined metals and organics demo has shown how a single deployment can collect data for both metals and organic compounds thus reducing the cost if both are desired at a single location. Lab analysis costs are increased but are offset by logistical and travel costs.

6.1.1 Pre-Operational Phase Costs

The costs incurred prior to field operations are derived from expenses involved with: site research and applicability; logistics planning and scheduling; equipment maintenance and repair; and pre-deployment readiness preparations (supplies, packing, checkout). Table 23 and Figure 78 below include expected pre-operational phase costs and an associated schedule of activities.

Table 23. Expected Pre-Operational Phase Costs for BFSD2 Deployment.

	Labor		Non-Labor		Totals
	Govt	Contr	Matls	Other	
Site Research	$5,580	$0	n/a	$1,000	**$6,580**
Logistics Plans	$7,000	$0	n/a	$0	**$7,000**
Maint and Repair	$1,600	$4,200	$500	$0	**$6,300**
Readiness Prep	$2,000	$10,850	$500	$0	**$13,350**
Totals	**$16,180**	**$15,050**	**1000**	**$1,000**	**$33,230**

No.	Activity	Cost
1	Pre-Operational Phase	$33,230
2	Site Research	$6,580
3	Historica Reports	$1,000
4	Current Reports	$1,000
5	Site Survey	$2,580
6	Analysis/Interpretation/Report	$2,000
7	Logistics Planning/Scheduling	$7,000
8	Prepare Plan	$1,000
9	Facilities/Equip/Support	$2,000
10	Access/Clearance/Permits	$2,000
11	Support Contract	$2,000
12	Equip Maint and Repair	$6,300
13	Supplies	$500
14	Readiness Preparation	$13,350
15	Test/Checkout	$10,600
16	Supplies	$1,400
17	Packing	$1,350

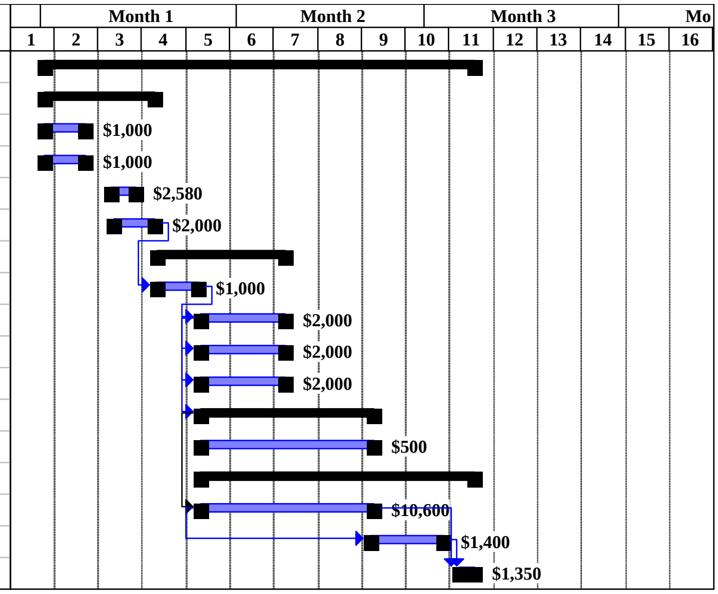


Figure 78. Expected Pre-Operational Phase Schedule for BFSD2 Deployment.

6.1.2 Operational Phase Costs

The costs incurred for field operations are derived from expenses involved with: equipment transportation; personnel travel and per diem; field facilities (shoreside work area, surface vessel, handling equipment); deployment, recovery and turnaround on a 5-day cycle; and analytical laboratory costs for one blank test and the required number of sites. Table 24 and Figure 79 below include expected operational phase costs and an associated schedule of activities.

Table 24. Expected Operational Phase Costs for BFSD2 Deployment.

	Labor		Non-Labor			Totals
	Govt	Contr	Matls	Lab	Other	
Equip Trans	$100	$200	$0	n/a	$1,000	**$1,300**
Travel	$800	$600	$0	n/a	$1,240	**$2,640**
Equip/Facilities	$1,600	$1,200	$0	$0	$0	**$2,800**
Blank Test	$4,000	$3,000	$0	$12,000	$1,200	**$20,200**
Site #1	$4,000	$3,000	$0	$12,000	$2,700	**$21,700**
Site #2	$4,000	$3,000	$0	$12,000	$2,700	**$21,700**
Totals	**$14,500**	**$11,000**	**$0**	**$36,000**	**$8,840**	**$70,340**

No.	Activity	Cost
18	Operational Phase	$70,340
19	Equipment Transportation	$1,300
20	Personnel Travel	$2,640
21	Equipment/Facilities setup/checkout	$2,800
22	Blank Test	$20,200
23	Blank Test	$8,200
24	Lab Anaysis	$12,000
25	Site #1	$21,700
26	Decon/Deploy/Recover	$9,700
27	Lab Analysis	$12,000
28	Site #2	$21,700
29	Decon/Deploy/Recover	$9,700
30	Lab Analysis	$12,000

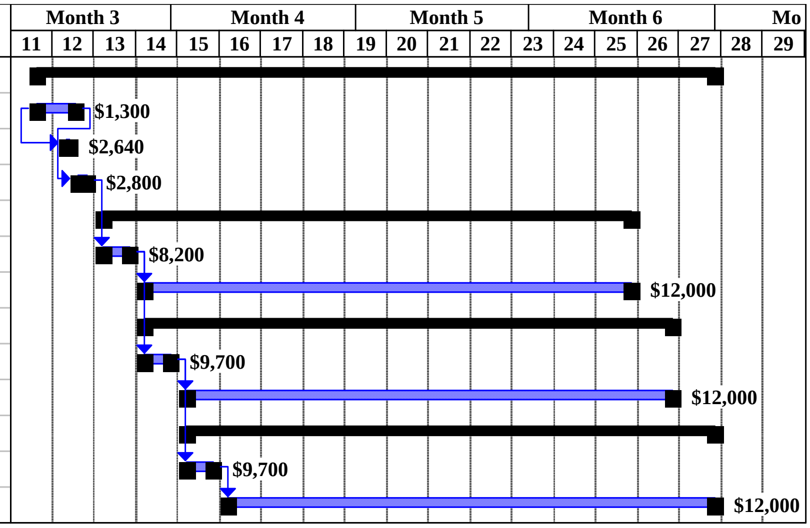


Figure 79. Expected Operational Phase Schedule for BFSD2 Deployment.

The operational phase costs for one site, which includes the costs for transportation, setup and a blank test are $48,640, of which 49% is for analysis of the samples. Each additional site adds $21,700 to the total, of which 55% is for analysis of the samples. The operational phase schedule is likewise strongly driven by the standard 60-day laboratory analysis time, which can be shortened to 30-days or less, at additional cost. The 5-day operations period for a BFSD2 72-hour deployment, recovery and turnaround cycle fits conveniently with a standard workweek schedule. An accelerated schedule which shortens turnaround time and includes weekend work periods can achieve two deployments per week.

6.1.3 Post-Operational Phase Costs

The costs incurred following completion of site operations are derived from expenses involved with: equipment packing and transportation; personnel travel; data processing, analysis and interpretation; report preparation. Table 25 and Figure 80 below include expected post-operational phase costs and an associated schedule of activities.

Table 25. Expected Post-Operational Phase Costs for BFSD2 Deployment.

	Labor		Non-Labor			Totals
	Govt	Contr	Matls	Lab	Other	
Equip Pkg/Trans	$0	$1,500	$0	n/a	$1,000	**$2,500**
Travel	$800	$600	$0	n/a	$1,240	**$2,640**
Data Review	$20,000	$13,000	$0	$0	$0	**$33,000**
Report Prep	$24,000	$0	$0	n/a	$0	**$24,000**
Totals	**$44,800**	**$15,100**	**$0**	**$0**	**$2,240**	**$62,140**

No.	Activity	Cost
31	**Post-Operational Phase**	**$62,260**
32	**Equipment Packing/Transportation**	**$2,500**
33	**Personnel Travel**	**$2,640**
34	**Data Processing, Analysis, Interpretat**	**$33,120**
35	**Report Preparation**	**$24,000**

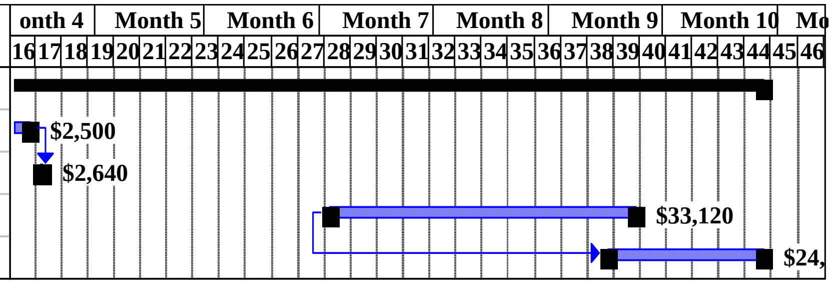


Figure 80. Expected Post-Operational Phases Schedule for BFSD2 Deployment.

The post-operational phase costs are largely the labor costs to process, analyze, interpret and report the results of the BFSD2 deployments. The costs are approximately the same regardless of the number of deployments as long as the sites have generally common geophysical and geochemical characteristics. The schedule is driven by the inactive period of time while awaiting results from laboratory analysis of the samples.

6.1.4 Alternative Methods

As discussed extensively in key reference 3, alternative sample collection methods to BFSD2's *in situ* collection and filtering of samples from the sediment-water diffusive interface are available. As with BFSD2, samples collected with alternative methods will require equivalent specialized laboratory analyses in order to determine contaminant flux rates. Those costs would be equivalent. Thus a direct comparison focusing on the method of sample collection is useful. Available alternate methods fall into two approaches, *ex situ* and *in situ*. Either of the approaches introduce error sources not present with BFSD2 and minimizing the affects of the error sources increases costs and complexity. Sample integrity becomes a significant factor. These issues aside, *ex situ* approaches can be as much as 50% cheaper for the field work, but this advantage quickly disappears with sediment processing costs. Alternative *In Situ* approaches, where applicable, may yield even greater savings than 50% for the field work, but careful consideration of the factors discussed below may discourage their use.

Both alternative approaches involve isolation of sediment pore water. With either approach, the primary source of error is the oxidation of anoxic pore water, which can significantly alter the aqueous phase trace metals. To prevent oxidation, samples must be processed and handled in an inert atmosphere, typically nitrogen or argon. *Ex Situ* methods typically first collect sediment samples which then require additional processing to extract pore water – requiring an inert atmosphere. Centrifuging or squeezing the sediment are accepted practices, but they too introduce error sources including solid-solution interactions. Sectioning samples prior to extraction to resolve sample depth for gradient determinations also adds cost and introduces errors. In addition, *Ex Situ* samplers must be rugged enough for field use yet provide isolation of the sediment sample from metal components. This is particularly difficult for dredging and grab sampling equipment however coring equipment can include non-metallic sleeves. Alternative *in situ* methods collect pore water samples at the sediment interface using either suction filtration techniques or dialysis. *In Situ* filtration techniques are limited to coarse grain sediments and do not offer depth resolution. Dialysis techniques incur minimum error sources, but suffer sample collection times as long as 20 days and produce small sample volumes. Periodic sample collection comparable to BFSD2 could require months, which in turn raises a number of additional issues.

7. Regulatory Issues

7.1 Approach to Regulatory Compliance and Acceptance

Regulatory acceptance has been a fundamental part of this project from the start and was included in the initial execution plan. The approach included application to the California Environmental Protection Agency (CA EPA), Department of Toxic Substances Control (DTSC) program known as "Cal Cert". A formal "Services Agreement" was signed with the State of California and funded for technology evaluation and certification services. In addition, CA EPA membership in the Interstate Technology and Regulatory Cooperation (ITRC) group of the Western Governors Association (WGA) and the resulting multi-state recognition of certified technologies by at least the 26 member states' environmental protection agencies promotes recognition and acceptance the BFSD2. Recognition and acceptance by the U.S. Environmental Protection Agency (US EPA), as well as private sector, Native American and foreign interests, is also promoted by their active participation in the ITRC. And, US EPA, state, local and private environmental professionals, as well as CA EPA evaluators were in attendance at field demonstrations, which included technology briefings and displays. Finally, certification by CA EPA includes public notifications and listings officially distributed to a wide range of recipients.

The Cal Cert application involved CA EPA review of the technology including background publications, reports, test and evaluation data, and a SSC SD site visit for technical discussions and equipment inspection. Due to the unique nature of the BFSD2 technology, a DTSC-wide search for a qualified lead technology evaluator was necessary to locate and secure the services needed for this project. Following acceptance of the Cal Cert application a performance claim was made by SSC SD After initial certification for metals, the CA Cert formal Services Agreement was amended to include organics applications. Additional funds to support their organics evaluation were provided also as amendments to previous documents.

The demonstrations performed for this project were key elements in the Cal Cert process. CA EPA evaluators reviewed the site selections, the test plans and attended the field demonstrations. Independent measurements, data review and analyses were accomplished by the CA EPA evaluators. Appendix F is the formal Cal Cert certificate and publicly released report. The Final Technology Evaluation report is listed in References, Section 10.

8. Technology Implementation

8.1 DoD Need

Sediments in many US bays and harbors are contaminated with potentially harmful metal and organic compounds. Contamination occurred directly through disposal of shipyard and shipboard waste, and indirectly through urban runoff and groundwater exchange with land sites. Federal, state and local regulatory agencies are in the process of adopting strict sediment quality criteria. These regulations represent a significant compliance issue for the DoD relative to discharge practices, dredging operations and clean-up techniques. Previous studies indicate that biological uptake, accumulation, and toxicity result primarily from the fraction of the toxicant pool that is readily solubilized. In surface sediments, the production of this soluble fraction will, in most cases, cause it to migrate through the pore water and across the sediment-water interface. Contaminated sediments at DoD sites pose a potential human health and ecological risk. Source control programs will not eliminate sediment contamination immediately because of the slow degradation and cycling processes that control many pollutants in these systems

For these reasons, benthic toxicant fluxes can provide a unique *in situ* indicator of bioavailability and hence an estimate of the potential for risk to human health or environmental harm. Using direct measurements, DoD can reduce the escalating costs of compliance and remediation of contaminated sediments by determining if the contamination poses a significant risk for remobilization. Quantifying the mobility of these in-place contaminants is an essential requirement for deciding the proper method of remediation. The complexity of marine sediment systems makes it very difficult to predict contaminant mobility by indirect methods. There is currently no other satisfactory direct means of quantifying the mobility of contaminants from marine sediments except the Benthic Flux Sampling Device (BFSD2 and its prototype version).

8.2 Transition

Technology transition of the BFSD2 is well underway. It consists of commercialization, regulatory acceptance, product improvement, and performance extension elements.

8.2.1 Commercialization

BFSD2 is a commercialized version of the prototype BFSD. The prototype BFSD was used during the Research, Development, Test and Evaluation (RDTE) phase of the program and was followed by fabrication of BFSD2 during the subsequent Acquisition phase. A Technical Data Package (TDP) and procurement package were generated to support a fixed-price, competitive contract solicitation for fabrication of a commercialized version of the prototype BFSD, called BFSD2. The winner, Ocean Sensors, Incorporated in San Diego, utilized commercial-off-the-shelf (COTS) and replaceable/repairable assemblies in meeting the requirements of the TDP.

8.2.1.1 Cooperative Research and Development Agreement

A Cooperative Research and Development Agreement (CRADA) was negotiated with Ocean Sensors, Inc., however it was not formalized and consummated. The company suggested, and SSC SD agreed, that a formal CRADA would not promote its goals for producing additional systems for other customers in response to market demand. No conflicting intellectual property issues were identified with their strategy and the company is currently awaiting new orders.

8.2.2 Regulatory Acceptance

See Approach to Regulatory Compliance and Acceptance, Section 7.1.

8.2.3 Product Improvement

Both incremental and continuing product improvements have been included in technology implementation. New methods, processes and procedures applicable to the BFSD2 were evaluated for use as a result of problems, constraints or other drawbacks identified during operations.

8.2.3.1 Incremental Product Improvements

Incremental improvements were implemented during the project, such as: reconfiguring the circulation pump for improved flow rate control: reconfiguring for *in situ* sample filtration using vacuum-filled collection bottles; installation of a insertion sensor subsystem to assure minimum sediment penetration; installation of a subsystem to inject sodium bromide into the collection chamber as a conservative tracer to facilitate more accurate volume determination. Care was taken to assure that such improvements did not invalidate ongoing certification efforts.

8.2.3.2 Continuing Product Improvements

Continuing improvements were implemented during the project, such as: method, timing and location for collection of a suitable ambient water sample; numerous computational spreadsheet data reduction, processing and display improvements; numerous improvements for turnaround cleaning and preparation; processes and procedures to improve maintenance and minimize corrosion. Again, care was taken to assure that such improvements did not invalidate ongoing certification efforts.

9. Lessons Learned

9.1 Flexibility

This project has been relatively straight forward and trouble free. As with any multi-faceted program which involves a complex new technology, flexibility must be maintained in order to accommodate any number of emergent issues. Plans and schedules must flex to allow for changes. This project suffered delayed funding at several points, but plans were flexible enough to allow work around efforts which ultimately recovered schedule losses. Technical approaches must flex to allow for changes. This project benefited from a number of incremental and continuing product improvements which were accommodated within the technical approach without invalidating demonstration results.

9.2 Mother Nature

Earlier studies had forecast it and it was clear from demonstration results that contaminated sediments are non-homogeneous and are subject to influences involving benthic organisms, complex marine geochemistry, and other factors. Accommodation of differences between blank measurements made a few days apart and site measurements made a few feet apart were necessary.

9.3 Statistics

With consideration for the very low levels of contaminants being measured (parts per *billion* and lower!) metrics involving statistical methods were needed to put meaning to results. Accommodation for results in terms of probabilities and confidence levels must be made to tease out the true meaning of some flux measurements. All throughout, consistent and repeatable materials, processes and procedures were necessary to minimize their influence on true results.

10. References

Key References

1. A.Tengberg, et al "Benthic Chamber and Profiling Landers in Oceanography - A Review of Design, Technical Solutions and Functioning"
2. A.Tengberg, et al,Draft - "Hydrodynamics in Benthic Chambers for *In Situ* Studies I: Results from an Intercalibration Involving 14 Different Designs", 8 Mar 1997
3. S.E.Bufflap and Herbert E. Allen, "Sediment Pore Water Collection Methods for Trace Metal Analysis: A Review", *Wat. Res.* Vol. 29, No. 1, pp 165-177, 1995
4. D.B.Chadwick, et al "A Benthic Flux Chamber for Monitoring Pollution Exchange Rates at the Sediment-Water Interface"
5. D.B.Chadwick, et al "Autonomous Benthic Lander for Polluted Bays, Harbors", *Sea Technology*
6. D.B.Chadwick, et al "An Instrument for the *In Situ* Measurement of Contaminant Flux Rates at the Sediment-water Interface", submitted to *Environmental Science and Technology*
7. J.M.Leather, et al "Contaminant Flux Measurements Across the Sediment-Water Interface in San Diego Bay", *Oceans '95*
8. NCCOSC RDTE Div, Code 52 Draft Final Report, "Sediment Quality Characterization - Naval Station San Diego", October 1996
9. NCCOSC RDTE DIV San Diego Contract N66001-97-C-0049 Awarded to Ocean Sensors, Inc., 21 Mar 1997
10. SPAWARSYSCEN San Diego contract N66001-98-D-5015 awarded to Tetra Tech, Inc., 26 August 1998
11. Technology Demonstration Plan for ESTCP Project 199712, *In Situ* Instrument for Quantifying Contaminant Mobility in marine Sediments, May 1998
12. California EPA Technical Report of Evaluation and Certification of Benthic Flux Sampling Device, Report TBD
13. ESTCP General Cost and Performance Report Guidance for Site Characterization Projects, June 1998 (Draft)
14. ESTCP Final Report Guidelines for Funded Projects, 15 April 1996

General References

1. Berelson, WM., D.E. Hammond, K.L. Hinga, G.T. Rowe, and F. Sayles, 1987. *In Situ* Benthic Flux Measurement Devices: Bottom Lander Technology. MTS Journal, V.21(2):26-32.
2. Berner, R.A., 1980. *Early Diagenesis: A Theoretical Approach*. Princeton University Press, Princeton, New Jersey, 241p.
3. Casas, A.M., and E.A. Crecelius, 1994. Relationship Between acid Volatile Sulfide and the Toxicity of Zinc, Lead, and Copper in Marine Sediments. Environmental Toxicology and Chemistry, V.13(3):529-536.
4. Chadwick, D.B., S.D. Stanley, and S.H. Lieberman, 1993. A Benthic Flux Chamber for Monitoring Pollution Exchange Rates at the Sediment-water Interface. Proceedings Oceans '93:196-206.
5. Di Toro, D.M., J.D. Mahony, D.J. Hansen, K.J. Scott, M.B. Hicks, S.M. Mayr, and M.S. Redmond, 1990. Toxicity of Cadmium in Sediments: the Role of Acid Volatile Sulfides. Environmental Toxicology and Chemistry, V. 9:1487-1502.
6. Huettel, M., and G. Gust, 1992. Solute Release Mechanisms from Confined Sediment Cores in Stirred Benthic Chambers and Flume Flows. Marine Ecology Service, V.82:187-197.
7. Rhoads, D.C., R.C. Aller, and M.B. Goldhaber, 1977. The Influence of Colonizing Benthos on Physical Properties and Chemical Diagenesis of the Estuarine Seafloor. In Coull, B.C. (ed), *Ecology of Marine Benthos*, University of South Carolina Press, Columbia, pp. 113-138.
8. Westerlund, S.F.G., L.G. Anderson, P.O.J. Hall, A. Iverfelt, M.M. Rutgers van der Loeff, and B. Sundy, 1986. Benthic Fluxes of Cadmium, Copper, Nickel, Zinc, and Lead in the Coastal Environment. Geochimica et Cosmochimica Acta, V.50:1289-1296.
9. Lee, C. and S.G. Wakeham, 1989. Organic Matter in Seawater: Biogeochemical Processes. In: J.P Riley (ed.), Chemical Oceanography, Academic Press, New York, pp.2-51.
10. NCCOSC RDTE Div Brochure TD 2790, “Benthic Flux Sampling Device”, April 1995
11. R.F.Chen, et al “Benthic Fluxes of Organic Compounds by Time-resolved Spectrofluorometry”
12. NCCOSC RDTE Div Technical Document 2434, “An Evaluation of Contaminant Flux Rates from Sediments of Sinclair Inlet, WA, Using a Benthic Flux Sampling Device”, February 1993
13. NCCOSC RDTE Div Technical Document 2435, “Benthic Flux Sampling Device Prototype Design, Development, and Evaluation”, August 1993
14. NCCOSC RDTE Div Technical Document 2387, “Benthic Flux Sampling Device - Operations, Methods, and Procedures”, February 1993
15. United States Environmental Protection Agency, 1988. Toxic Sediments: Approaches to Management. EPA 68-01-7002.

Appendix A

Points of Contact

1. Project Manager and Principal Investigator:

Combined Demo:

Bradley Davidson
Space and Naval Warfare Systems Center, Code D3604
53475 Strothe Road, Bldg 111
San Diego, CA 92152
Phone – 619-553-2804
Fax – 619-553-6305
Emai – bradley.davidson@navy.mil

Metals only and Organics only Demos:

Tom Hampton
Space and Naval Warfare Systems Center, Code D3604
53475 Strothe Road, Bldg 111
San Diego, CA 92152
Phone – 619-553-1172
Fax – 619-553-1177
Email – thampton@spawar.navy.mil

2. Co-Investigator:

Bart Chadwick, PhD
Space and Naval Warfare Systems Center, Code D362
53475 Strothe Road, Bldg 149
San Diego, CA 92152
Phone – 619-553-5333
Fax – 619-553-6305
Email – chadwick@spawar.navy.mil

3. California EPA Certification Evaluators:

Bruce Labelle, PhD
Department Of Toxic Substances Control
301 Capitol Mall, 1st floor
Sacramento, California 95814
Phone – 916-322-5591
Fax – 916-327-4494 or 445-2939
Email Blabelle@DTSC.Ca.Gov

John Wesnousky
Department of Toxic Substance Control
California Environmental Protection Agency
301 Capitol Mall, 1st Floor
Sacramento, CA 95814
Phone - 916-322-2543
Fax - 916-327-4494
Email JWesnousky@DTSC.Ca.Gov

4. Pearl Harbor Naval Complex Host:

Peter Nakamura
Naval Facilities Command, Pacific Division
Honolulu, HA
Phone – 808- 474-4505
Fax – 808- 474-4519
Email – NakamuraPM@efdpac.navfac.navy.mil

5. Commercialization Contractor:

Kim McCoy
Ocean Sensors, Inc
4901 Morena Blvd, Suite 1001
San Diego, CA 92117
Phone – 619-274-9893
Fax – 619-274-9895
Email – kmccoy@adnc.com

6. Development Sponsor:

Andy DelCollo
Naval Facilities Command
Washington DC
Phone – 202-685-9173
Fax – 202-685-1569
Email - delcolloa@navfac.navy.mil

7. Demonstration and Validation Sponsor:

Jeff Marqusee, Ph.D.
Office of Under Secretary of Defense (Environmental Security)
Environmental Security Technology Certification Program
Washington DC
Phone – 703-696-2120
Fax – 703-696-2114
Email - marqusj@acq.osd.mil

Appendix B

Spreadsheet Products for Each Demonstration

Bishop Point Combined - PAHs first 4 (Part 1)
Bishop Point Combined - PAHs first 4 (Part 2)
BP Organics Demo - PAHs (Part1)
BP Organics Demo - PAHs (Part1-First 4 Samples)
BP Organics Demo - PAHs (Part1-last 8 samples)
BP Organics Demo - PAHs (Part 2)
BP Organics Demo - PAHs (Part 2
BP Organics Demo - PAHs (Part 2
BP Organics Demo-PCBs
BP Organics Demo-Pesticides
PC Organics Demo - PAHs (Part1)
PC Organics Demo - PAHs (Part 2)
PC Organics Demo-PCBs
PC Organics Demo-Pesticides
BFSD2 Blank Tests (CA Cert)-Metals
BFSD2 Blank Tests- PAHs (CA Cert)
BFSD2 Blank Tests- PCBs (CA Cert)
BFSD2 Blank Tests- Pesticides (CA Cert)
BFSD2 PCD(All-CA Cert)
BFSD2 PCPD(All-CA Cert)
BFSD2 PHBP(All-CA Cert)
BFSD2 PHML(All-CA Cert)
Bishop Point Combined - Metals_1
Bishop Point Combined - PAHs (Part 1)
Bishop Point Combined - PAHs (Part 2)

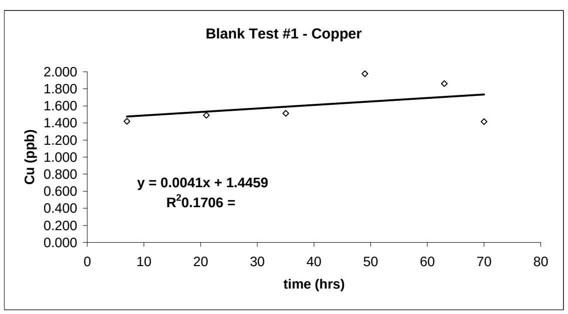
BFSD 2 Triplicate Blank Tests
Copper

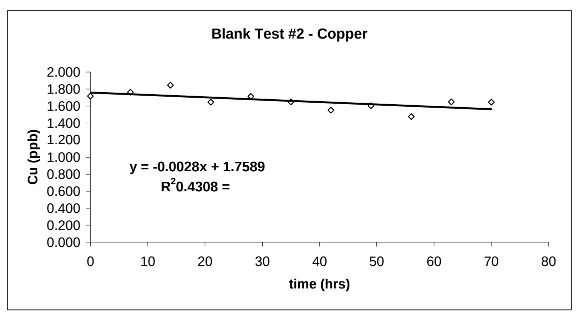
Site: End of SSC,SD Pier 159
Date: 5/14-5/31/98 (3 tests)

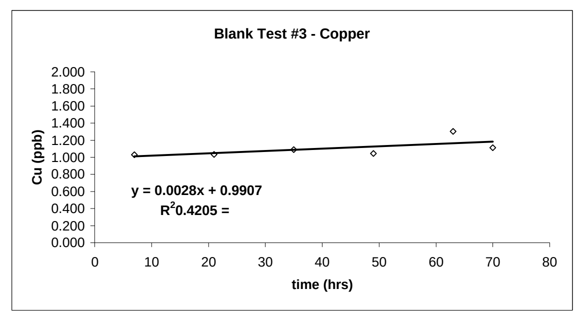
Start time: See indivdual tests
Duration/Interval: 77hrs (min)/7 hrs
End time: See individual tests

*Note: See individual tests for "Time 0 Ambient" sample id (Sample T-#0)

Sample id	BFSD 2 Data: Measured Concentration (ppb)**	BFSD 2 Data: Sample No.*	BFSD 2 Data: Elapsed Time (hrs)	Dilution Correction: Measured Concentration (ppb)**	Dilution Correction: Corrected Concentration (ppb)**	Dilution Correction: # of Dilutions	From Regression Concentration (ppb)**	Linear Regression Statistics				
										Bottle Volume =	0.235	liters
										Blank Chamber Volume =	42.97	liters
										Chamber Area =	1701.4	cm^2
Copper (Cu)												
Test #1								Regression Output:				
	1.42	T-#0		1.420				Constant	1.446			
BT1-03	1.42	#1	7	1.420	1.420	0	1.475	Std Err of Y Est	0.211			
BT1-05	1.50	#2	21	1.500	1.492	2	1.532	R Squared	0.171			
BT1-07	1.53	#3	35	1.530	1.515	4	1.590	No. of Observations	6	Flux = 25 ug/m^2/day		
BT1-09	2.00	#4	49	2.000	1.978	6	1.648	Degrees of Freedom	4			
BT1-11	1.89	#5	63	1.890	1.863	8	1.705			80% CI (low) =	**-17**	$\mu g/m^2/day$
BT1-12	1.44	#6	70	1.440	1.416	9	1.734	X Coefficient(s)	0.004	(high) =	**67**	$\mu g/m^2/day$
								Std Err of Coef.	0.005			
Test #2												
								Regression Output:				
BT2-01	2.57	T-#0	-0.1	2.574		n/a		Constant	1.759			
BT2-02	1.72	#1	0	1.718	1.718	0	1.759	Std Err of Y Est	0.045			
BT2-03	1.77	#2	7	1.769	1.764	1	1.739	R Squared	0.431			
BT2-04	1.85	#3	14	1.853	1.844	2	1.719	No. of Observations	12	Flux = -17 ug/m^2/day		
BT2-05	1.66	#4	21	1.660	1.647	3	1.700	Degrees of Freedom	4			
BT2-06	1.73	#5	28	1.730	1.712	4	1.680			80% CI (low) =	**-27**	$\mu g/m^2/day$
BT2-07	1.67	#6	35	1.671	1.648	5	1.660	X Coefficient(s)	-0.003	(high) =	**-7**	$\mu g/m^2/day$
BT2-08	1.58	#7	42	1.579	1.551	6	1.640					
BT2-09	1.64	#8	49	1.639	1.606	7	1.621					
BT2-10	1.52	#9	56	1.515	1.477	8	1.601					
BT2-11	1.69	#10	63	1.693	1.649	9	1.581					
BT2-12	1.69	#11	70	1.693	1.644	10	1.561					
								Std Err of Coef.	0.001			
Test #3												
								Regression Output:				
	1.03	T-#0		1.030				Constant	0.991			
BT3-02	1.03	#1	7	1.030	1.030	0	1.010	Std Err of Y Est	0.075			
BT3-04	1.04	#2	21	1.040	1.034	2	1.049	R Squared	0.420			
BT3-06	1.10	#3	35	1.102	1.091	4	1.087	No. of Observations	6	Flux = 17 ug/m^2/day		
BT3-08	1.06	#4	49	1.063	1.047	6	1.126	Degrees of Freedom	4			
BT3-10	1.33	#5	63	1.326	1.304	8	1.164			80% CI (low) =	**2**	$\mu g/m^2/day$
BT3-12	1.14	#6	70	1.140	1.114	10	1.184	X Coefficient(s)	0.003	(high) =	**32**	$\mu g/m^2/day$
								Std Err of Coef.	0.002			







BFSD 2 Triplicate Blank Tests
Cadmium

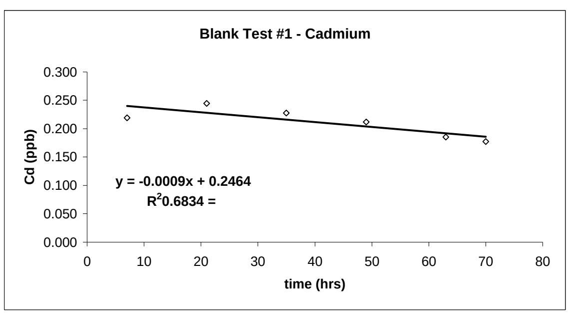
Site: End of SSC,SD Pier 159
Date: 5/14-5/31/98 (3 tests)

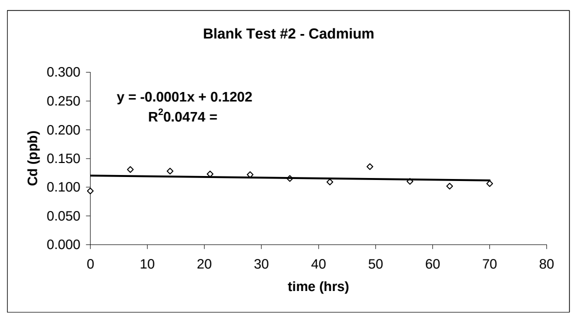
Start time: See indivdual tests
Duration/Interval: 77hrs (min)/7 hrs
End time: See individual tests

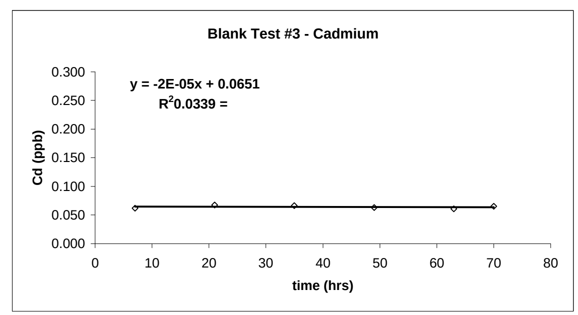
*Note: See individual tests for "Time 0 Ambient" sample id (Sample T-#0)

Bottle Volume =	0.235	liters
Blank Chamber Volume =	42.97	liters
Chamber Area =	1701.4	cm^2

Sample id	BFSD 2 Data: Measured Concentration (ppb)**	Sample No.*	Elapsed Time (hrs)	Dilution Correction: Measured Concentration (ppb)**	Corrected Concentration (ppb)**	# of Dilutions	From Regression Concentration (ppb)**	Linear Regression Statistics				
Cadmium (Cd)												
Test #1								Regression Output:				
	0.219	T-#0		0.219				Constant	0.246			
BT1-03	0.219	#1	7	0.219	0.219	0	0.240	Std Err of Y Est	0.014			
BT1-05	0.246	#2	21	0.246	0.245	2	0.228	R Squared	0.683			
BT1-07	0.230	#3	35	0.230	0.228	4	0.216	No. of Observations	6	Flux = -5.3 ug/m^2/day		
BT1-09	0.215	#4	49	0.215	0.212	6	0.204	Degrees of Freedom	4			
BT1-11	0.190	#5	63	0.190	0.185	8	0.192			80% CI (low) =	**-8.0**	$\mu g/m^2/day$
BT1-12	0.182	#6	70	0.182	0.177	9	0.186	X Coefficient(s)	-0.001	(high) =	**-2.5**	$\mu g/m^2/day$
								Std Err of Coef.	0.000			
Test #2								Regression Output:				
BT2-01	0.0752	T-#0	-0.1	0.075		n/a		Constant	0.120			
BT2-02	0.0937	#1	0	0.094	0.094	0	0.120	Std Err of Y Est	0.008			
BT2-03	0.131	#2	7	0.131	0.131	1	0.119	R Squared	0.047			
BT2-04	0.128	#3	14	0.128	0.128	2	0.118	No. of Observations	12	Flux = -0.7 ug/m^2/day		
BT2-05	0.122	#4	21	0.122	0.123	3	0.118	Degrees of Freedom	4			
BT2-06	0.121	#5	28	0.121	0.122	4	0.117			80% CI (low) =	**-2.5**	$\mu g/m^2/day$
BT2-07	0.114	#6	35	0.114	0.115	5	0.116	X Coefficient(s)	0.000	(high) =	**1.0**	$\mu g/m^2/day$
BT2-08	0.108	#7	42	0.108	0.109	6	0.115					
BT2-09	0.134	#8	49	0.134	0.136	7	0.114					
BT2-10	0.108	#9	56	0.108	0.110	8	0.113					
BT2-11	0.0998	#10	63	0.100	0.102	9	0.112					
BT2-12	0.104	#11	70	0.104	0.106	10	0.112					
								Std Err of Coef.	0.000			
Test #3								Regression Output:				
	0.0622	T-#0		0.062				Constant	0.065			
BT3-02	0.0622	#1	7	0.062	0.062	0	0.065	Std Err of Y Est	0.002			
BT3-04	0.0679	#2	21	0.068	0.068	2	0.065	R Squared	0.034			
BT3-06	0.0669	#3	35	0.067	0.066	4	0.064	No. of Observations	6	Flux = -0.12 ug/m^2/day		
BT3-08	0.0643	#4	49	0.064	0.063	6	0.064	Degrees of Freedom	4			
BT3-10	0.0623	#5	63	0.062	0.061	8	0.064			80% CI (low) =	**-0.59**	$\mu g/m^2/day$
BT3-12	0.0670	#6	70	0.067	0.065	10	0.064	X Coefficient(s)	0.000	(high) =	**0.36**	$\mu g/m^2/day$
								Std Err of Coef.	0.000			







BFSD 2 Triplicate Blank Tests
Lead

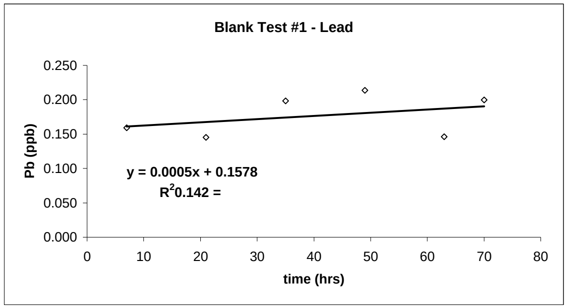
Site: End of SSC,SD Pier 159
Date: 5/14-5/31/98 (3 tests)

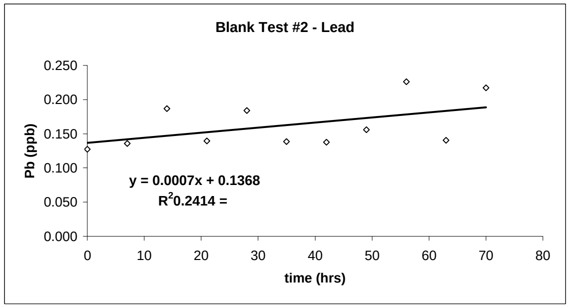
Start time: See indivdual tests
Duration/Interval: 77hrs (min)/7 hrs
End time: See individual tests

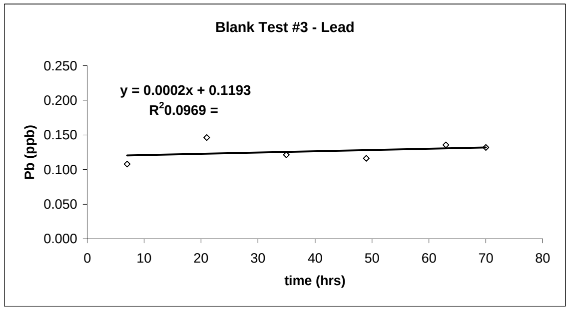
*Note: See individual tests for "Time 0 Ambient" sample id (Sample T-#0)

Bottle Volume =	0.235	liters
Blank Chamber Volume =	42.97	liters
Chamber Area =	1701.4	cm^2

	BFSD 2 Data			Dilution Correction			From	Linear Regression Statistics				
Sample id	**Measured Concentration** (ppb)**	**Sample No.***	**Elapsed Time** (hrs)	**Measured Concentration** (ppb)**	**Corrected Concentration** (ppb)**	**# of Dilutions**	**Regression Concentration** (ppb)**					
Lead (Pb)												
Test #1								Regression Output:				
	0.159	T-#0		0.159				Constant	0.158			
BT1-03	0.159	#1	7	0.159	0.159	0	0.161	Std Err of Y Est	0.027			
BT1-05	0.146	#2	21	0.146	0.145	2	0.168	R Squared	0.142			
BT1-07	0.200	#3	35	0.200	0.198	4	0.174	No. of Observations	6	Flux = 2.8 ug/m^2/day		
BT1-09	0.216	#4	49	0.216	0.214	6	0.181	Degrees of Freedom	4			
BT1-11	0.149	#5	63	0.149	0.146	8	0.187			80% CI (low) =	**-2.5**	$\mu g/m^2/day$
BT1-12	0.203	#6	70	0.203	0.200	9	0.191	X Coefficient(s)	0.000	(high) =	**8.2**	$\mu g/m^2/day$
								Std Err of Coef.	0.001			
Test #2								Regression Output:				
BT2-01	0.237	T-#0	-0.1	0.237		n/a		Constant	0.137			
BT2-02	0.128	#1	0	0.128	0.128	0	0.137	Std Err of Y Est	0.018			
BT2-03	0.137	#2	7	0.137	0.136	1	0.142	R Squared	0.241			
BT2-04	0.188	#3	14	0.188	0.187	2	0.147	No. of Observations	12	Flux = 4.5 ug/m^2/day		
BT2-05	0.141	#4	21	0.141	0.140	3	0.152	Degrees of Freedom	4			
BT2-06	0.186	#5	28	0.186	0.184	4	0.158			80% CI (low) =	**0.4**	$\mu g/m^2/day$
BT2-07	0.141	#6	35	0.141	0.138	5	0.163	X Coefficient(s)	0.001	(high) =	**8.6**	$\mu g/m^2/day$
BT2-08	0.141	#7	42	0.141	0.138	6	0.168					
BT2-09	0.159	#8	49	0.159	0.156	7	0.173					
BT2-10	0.230	#9	56	0.230	0.226	8	0.178					
BT2-11	0.144	#10	63	0.144	0.140	9	0.183					
BT2-12	0.221	#11	70	0.221	0.217	10	0.189					
								Std Err of Coef.	0.000			
Test #3								Regression Output:				
	0.108	T-#0		0.108				Constant	0.119			
BT3-02	0.108	#1	7	0.108	0.108	0	0.121	Std Err of Y Est	0.013			
BT3-04	0.147	#2	21	0.147	0.146	2	0.123	R Squared	0.097			
BT3-06	0.123	#3	35	0.123	0.122	4	0.126	No. of Observations	6	Flux = 1.1 ug/m^2/day		
BT3-08	0.118	#4	49	0.118	0.116	6	0.128	Degrees of Freedom	4			
BT3-10	0.138	#5	63	0.138	0.136	8	0.131			80% CI (low) =	**-1.5**	$\mu g/m^2/day$
BT3-12	0.134	#6	70	0.134	0.132	10	0.132	X Coefficient(s)	0.000	(high) =	**3.6**	$\mu g/m^2/day$
								Std Err of Coef.	0.000			







BFSD 2 Triplicate Blank Tests
Nickle

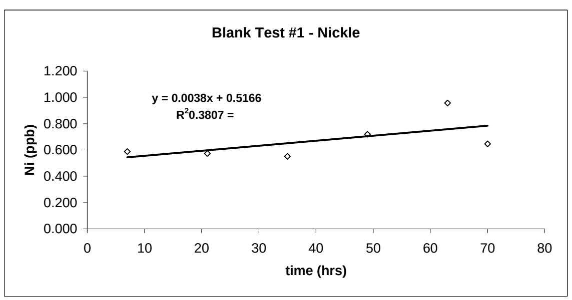
Site: End of SSC,SD Pier 159
Date: 5/14-5/31/98 (3 tests)

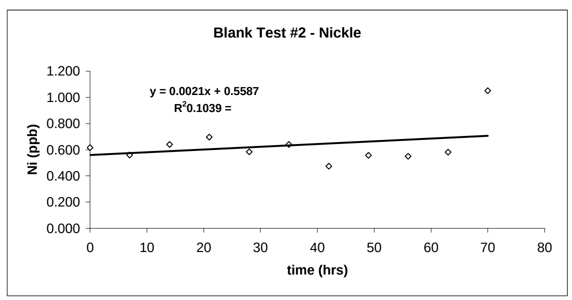
Start time: See indivdual tests
Duration/Interval: 77hrs (min)/7 hrs
End time: See individual tests

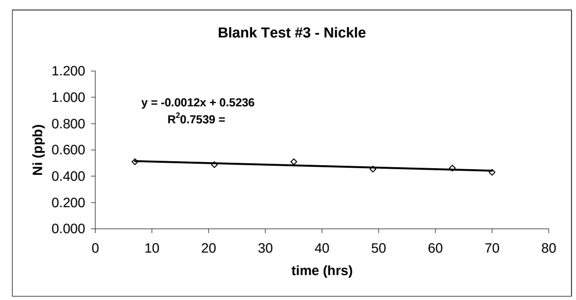
*Note: See individual tests for "Time 0 Ambient" sample id (Sample T-#0)

Bottle Volume = 0.235	liters
Blank Chamber Volume = 42.97	liters
Chamber Area = 1701.4	cm^2

Sample id	BFSD 2 Data: Measured Concentration (ppb)**	BFSD 2 Data: Sample No.*	BFSD 2 Data: Elapsed Time (hrs)	Dilution Correction: Measured Concentration (ppb)**	Dilution Correction: Corrected Concentration (ppb)**	Dilution Correction: # of Dilutions	From Regression Concentration (ppb)**	Linear Regression Statistics				
Nickle (Ni)												
Test #1								Regression Output:				
	0.589	T-#0		0.589				Constant	0.517			
BT1-03	0.589	#1	7	0.589	0.589	0	0.543	Std Err of Y Est	0.114			
BT1-05	0.577	#2	21	0.577	0.574	2	0.597	R Squared	0.381			
BT1-07	0.559	#3	35	0.559	0.552	4	0.651	No. of Observations	6	Flux = 23 ug/m^2/day		
BT1-09	0.730	#4	49	0.730	0.720	6	0.705	Degrees of Freedom	4			
BT1-11	0.970	#5	63	0.970	0.958	8	0.758			80% CI (low) =	**1**	$\mu g/m^2/day$
BT1-12	0.657	#6	70	0.657	0.647	9	0.785	X Coefficient(s)	0.004	(high) =	**46**	$\mu g/m^2/day$
								Std Err of Coef.	0.002			
Test #2								Regression Output:				
BT2-01	2.13	T-#0	-0.1	2.126		n/a		Constant	0.559			
BT2-02	0.615	#1	0	0.615	0.615	0	0.559	Std Err of Y Est	0.085			
BT2-03	0.568	#2	7	0.568	0.560	1	0.573	R Squared	0.104			
BT2-04	0.658	#3	14	0.658	0.641	2	0.588	No. of Observations	12	Flux = 13 ug/m^2/day		
BT2-05	0.721	#4	21	0.721	0.696	3	0.603	Degrees of Freedom	4			
BT2-06	0.618	#5	28	0.618	0.585	4	0.617			80% CI (low) =	**-6**	$\mu g/m^2/day$
BT2-07	0.681	#6	35	0.681	0.640	5	0.632	X Coefficient(s)	0.002	(high) =	**32**	$\mu g/m^2/day$
BT2-08	0.523	#7	42	0.523	0.474	6	0.647					
BT2-09	0.614	#8	49	0.614	0.556	7	0.661					
BT2-10	0.617	#9	56	0.617	0.551	8	0.676					
BT2-11	0.656	#10	63	0.656	0.582	9	0.691					
BT2-12	1.13	#11	70	1.134	1.052	10	0.705					
								Std Err of Coef.	0.002			
Test #3								Regression Output:				
	0.511	T-#0		0.511				Constant	0.524			
BT3-02	0.511	#1	7	0.511	0.511	0	0.515	Std Err of Y Est	0.016			
BT3-04	0.492	#2	21	0.492	0.489	2	0.499	R Squared	0.754			
BT3-06	0.516	#3	35	0.516	0.510	4	0.483	No. of Observations	6	Flux = -7.1 ug/m^2/day		
BT3-08	0.462	#4	49	0.462	0.454	6	0.466	Degrees of Freedom	4			
BT3-10	0.474	#5	63	0.474	0.462	8	0.450			80% CI (low) =	**-10.2**	$\mu g/m^2/day$
BT3-12	0.444	#6	70	0.444	0.429	10	0.442	X Coefficient(s)	-0.001	(high) =	**-4.0**	$\mu g/m^2/day$
								Std Err of Coef.	0.000			







BFSD 2 Triplicate Blank Tests
Manganese

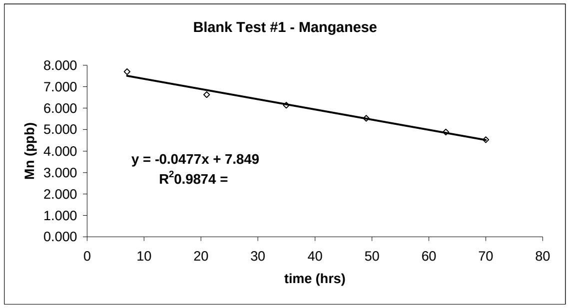
Site: End of SSC,SD Pier 159
Date: 5/14-5/31/98 (3 tests)

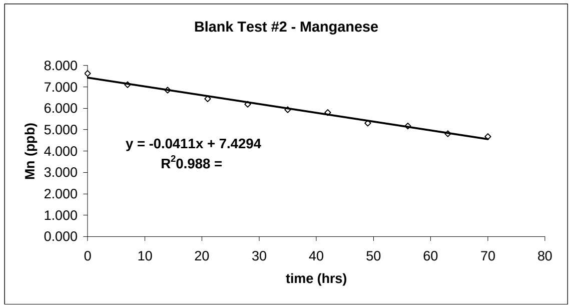
Start time: See indivdual tests
Duration/Interval: 77hrs (min)/7 hrs
End time: See individual tests

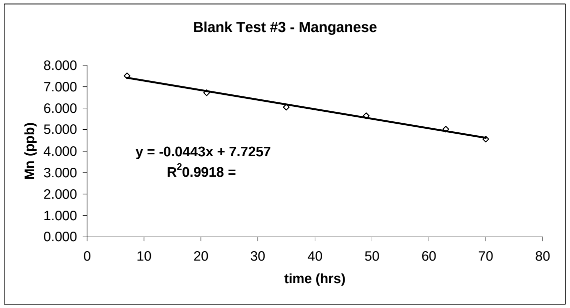
*Note: See individual tests for "Time 0 Ambient" sample id (Sample T-#0)

Bottle Volume =	0.235	liters
Blank Chamber Volume =	42.97	liters
Chamber Area =	1701.4	cm^2

Sample id	BFSD 2 Data: Measured Concentration (ppb)**	Sample No.*	Elapsed Time (hrs)	Dilution Correction: Measured Concentration (ppb)**	Corrected Concentration (ppb)**	# of Dilutions	From Regression Concentration (ppb)**	Linear Regression Statistics				
Manganese(Mn)												
Test #1								Regression Output:				
	7.70	T-#0		7.700				Constant	7.849			
BT1-03	7.70	#1	7	7.700	7.700	0	7.515	Std Err of Y Est	0.125			
BT1-05	6.67	#2	21	6.670	6.628	2	6.847	R Squared	0.987			
BT1-07	6.23	#3	35	6.230	6.140	4	6.179	No. of Observations	6	Flux = -289 ug/m^2/day		
BT1-09	5.66	#4	49	5.660	5.520	6	5.512	Degrees of Freedom	4			
BT1-11	5.08	#5	63	5.080	4.887	8	4.844			80% CI (low) =	**-314**	µg/m²/day
BT1-12	4.74	#6	70	4.740	4.532	9	4.510	X Coefficient(s)	-0.048	(high) =	**-264**	µg/m²/day
								Std Err of Coef.	0.003			
Test #2								Regression Output:				
BT2-01	7.80	T-#0	-0.1	7.803		n/a		Constant	7.429			
BT2-02	7.63	#1	0	7.632	7.632	0	7.429	Std Err of Y Est	0.063			
BT2-03	7.10	#2	7	7.097	7.096	1	7.141	R Squared	0.988			
BT2-04	6.85	#3	14	6.854	6.849	2	6.853	No. of Observations	12	Flux = -249 ug/m^2/day		
BT2-05	6.45	#4	21	6.454	6.444	3	6.565	Degrees of Freedom	4			
BT2-06	6.20	#5	28	6.198	6.181	4	6.277			80% CI (low) =	**-263**	µg/m²/day
BT2-07	5.96	#6	35	5.961	5.935	5	5.989	X Coefficient(s)	-0.041	(high) =	**-235**	µg/m²/day
BT2-08	5.84	#7	42	5.837	5.801	6	5.702					
BT2-09	5.35	#8	49	5.349	5.302	7	5.414					
BT2-10	5.23	#9	56	5.232	5.172	8	5.126					
BT2-11	4.88	#10	63	4.877	4.803	9	4.838					
BT2-12	4.76	#11	70	4.761	4.671	10	4.550					
								Std Err of Coef.	0.002			
Test #3								Regression Output:				
	7.50	T-#0		7.503				Constant	7.726			
BT3-02	7.50	#1	7	7.503	7.503	0	7.416	Std Err of Y Est	0.094			
BT3-04	6.76	#2	21	6.762	6.721	2	6.795	R Squared	0.992			
BT3-06	6.14	#3	35	6.137	6.051	4	6.175	No. of Observations	6	Flux = -269 ug/m^2/day		
BT3-08	5.78	#4	49	5.777	5.642	6	5.555	Degrees of Freedom	4			
BT3-10	5.21	#5	63	5.208	5.023	8	4.934			80% CI (low) =	**-287**	µg/m²/day
BT3-12	4.80	#6	70	4.797	4.558	10	4.624	X Coefficient(s)	-0.044	(high) =	**-250**	µg/m²/day
								Std Err of Coef.	0.002			







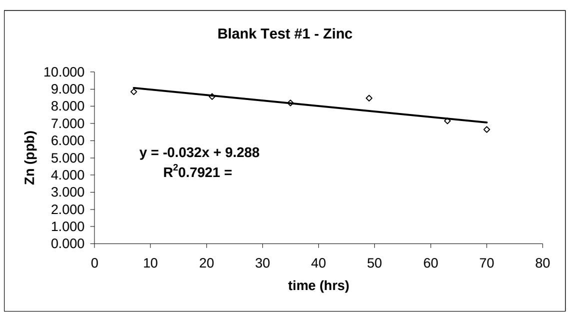
BFSD 2 Triplicate Blank Tests
Zinc

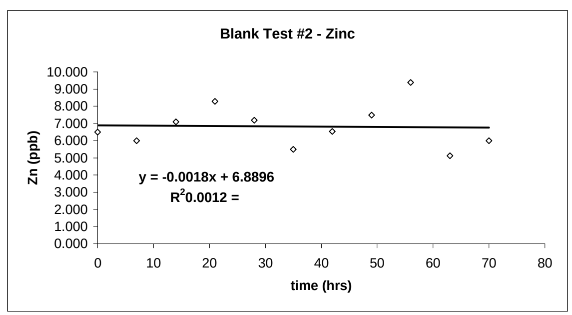
Site:	End of SSC,SD Pier 159	**Start time:**	See indivdual tests
Date:	5/14-5/31/98 (3 tests)	**Duration/Interval:**	77hrs (min)/7 hrs
		End time:	See individual tests

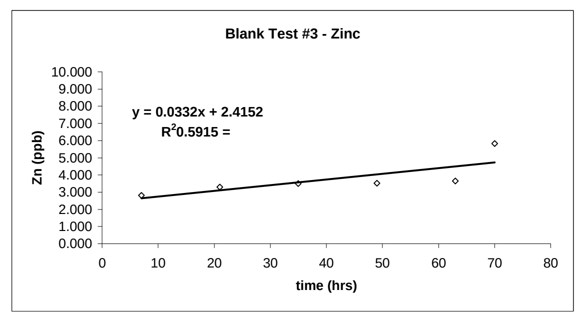
*Note: See individual tests for "Time 0 Ambient" sample id (Sample T-#0)

Bottle Volume =	0.235	liters
Blank Chamber Volume =	42.97	liters
Chamber Area =	1701.4	cm^2

	BFSD 2 Data			Dilution Correction			From	Linear Regression Statistics				
Sample id	**Measured Concentration**	**Sample No.***	**Elapsed Time**	**Measured Concentration**	**Corrected Concentration**	**# of Dilutions**	**Regression Concentration**					
	(ppb)**		(hrs)	(ppb)**	(ppb)**		(ppb)**					
Zinc (Zn)												
Test #1								Regression Output:				
	8.85	T-#0		8.850				Constant	9.288			
BT1-03	8.85	#1	7	8.850	8.850	0	9.064	Std Err of Y Est	0.381			
BT1-05	8.61	#2	21	8.610	8.562	2	8.617	R Squared	0.792			
BT1-07	8.30	#3	35	8.300	8.202	4	8.169	No. of Observations	6	**Flux = -194 ug/m^2/day**		
BT1-09	8.63	#4	49	8.630	8.480	6	7.722	Degrees of Freedom	4			
BT1-11	7.35	#5	63	7.350	7.151	8	7.274			80% CI (low) =	**-270**	$\mu g/m^2/day$
BT1-12	6.86	#6	70	6.860	6.653	9	7.051	X Coefficient(s)	-0.032	(high) =	**-118**	$\mu g/m^2/day$
								Std Err of Coef.	0.008			
Test #2												
								Regression Output:				
BT2-01	6.04	T-#0	-0.1	6.037		n/a		Constant	6.890			
BT2-02	6.50	#1	0	6.497	6.497	0	6.890	Std Err of Y Est	0.742			
BT2-03	5.99	#2	7	5.992	5.995	1	6.877	R Squared	0.001			
BT2-04	7.10	#3	14	7.102	7.104	2	6.864	No. of Observations	12	**Flux = -11 ug/m^2/day**		
BT2-05	8.28	#4	21	8.276	8.284	3	6.851	Degrees of Freedom	4			
BT2-06	7.17	#5	28	7.173	7.193	4	6.838			80% CI (low) =	**-178**	$\mu g/m^2/day$
BT2-07	5.46	#6	35	5.460	5.487	5	6.825	X Coefficient(s)	-0.002	(high) =	**155**	$\mu g/m^2/day$
BT2-08	6.51	#7	42	6.510	6.533	6	6.812					
BT2-09	7.46	#8	49	7.458	7.484	7	6.799					
BT2-10	9.35	#9	56	9.349	9.383	8	6.787					
BT2-11	5.06	#10	63	5.064	5.116	9	6.774					
BT2-12	5.96	#11	70	5.955	6.002	10	6.761					
								Std Err of Coef.	0.018			
Test #3												
								Regression Output:				
	2.82	T-#0		2.817				Constant	2.415			
BT3-02	2.82	#1	7	2.817	2.817	0	2.647	Std Err of Y Est	0.641			
BT3-04	3.31	#2	21	3.313	3.298	2	3.112	R Squared	0.592			
BT3-06	3.52	#3	35	3.521	3.493	4	3.576	No. of Observations	6	**Flux = 201 ug/m^2/day**		
BT3-08	3.56	#4	49	3.558	3.518	6	4.040	Degrees of Freedom	4			
BT3-10	3.71	#5	63	3.708	3.657	8	4.504			80% CI (low) =	**73**	$\mu g/m^2/day$
BT3-12	5.90	#6	70	5.895	5.833	10	4.737	X Coefficient(s)	0.033	(high) =	**329**	$\mu g/m^2/day$
								Std Err of Coef.	0.014			







BFSD 2 Triplicate Blank Tests
Silica Dioxide

Site: End of SSC,SD Pier 159
Date: 5/14-5/31/98 (3 tests)

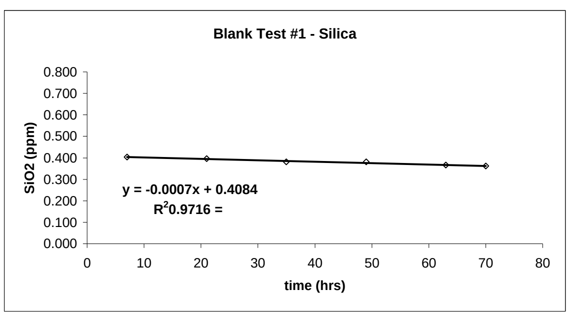
Start time: See indivdual tests
Duration/Interval: 77hrs (min)/7 hrs
End time: See individual tests

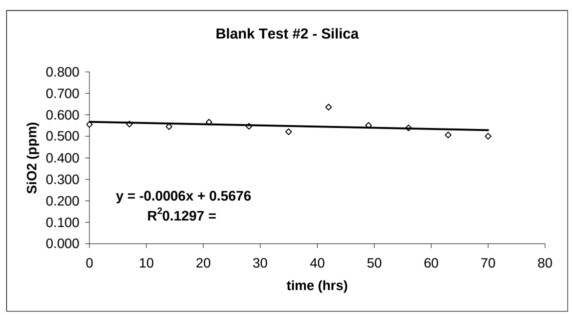
*Note: See individual tests for "Time 0 Ambient" sample id (Sample T-#0)

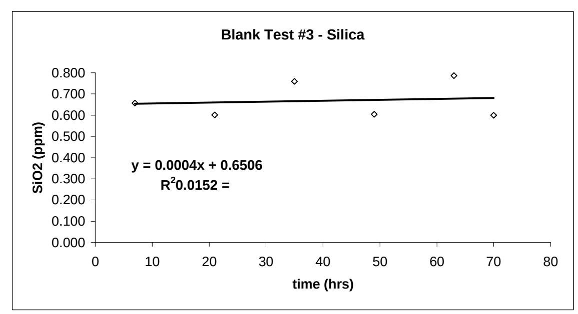
Bottle Volume =	0.235	liters
Blank Chamber Volume =	42.97	liters
Chamber Area =	1701.4	cm^2

Silica (SiO_2) — **Concentrations are in ppm (mg/L)

Sample id	BFSD 2 Data: Measured Concentration (ppb)**	Sample No.*	Elapsed Time (hrs)	Dilution Correction: Measured Concentration (ppb)**	Corrected Concentration (ppb)**	# of Dilutions	From Regression Concentration (ppb)**	Linear Regression Statistics				
Test #1								Regression Output:				
	0.403	T-#0		0.403				Constant	0.408			
BT1-03	0.403	#1	7	0.403	0.403	0	0.404	Std Err of Y Est	0.003			
BT1-05	0.398	#2	21	0.398	0.396	2	0.395	R Squared	0.972			
BT1-07	0.386	#3	35	0.386	0.382	4	0.386	No. of Observations	6	Flux = -4.0 mg/m^2/day		
BT1-09	0.388	#4	49	0.388	0.381	6	0.376	Degrees of Freedom	4			
BT1-11	0.376	#5	63	0.376	0.367	8	0.367			80% CI (low) =	**-4.5**	$mg/m^2/day$
BT1-12	0.371	#6	70	0.371	0.362	9	0.363	X Coefficient(s)	-0.001	(high) =	**-3.4**	$mg/m^2/day$
								Std Err of Coef.	0.000			
Test #2								Regression Output:				
BT2-01	0.581	T-#0	-0.1	0.581		n/a		Constant	0.568			
BT2-02	0.556	#1	0	0.556	0.556	0	0.568	Std Err of Y Est	0.020			
BT2-03	0.557	#2	7	0.557	0.557	1	0.564	R Squared	0.130			
BT2-04	0.545	#3	14	0.545	0.545	2	0.560	No. of Observations	12	Flux = -3.4 mg/m^2/day		
BT2-05	0.566	#4	21	0.566	0.566	3	0.556	Degrees of Freedom	4			
BT2-06	0.548	#5	28	0.548	0.547	4	0.552			80% CI (low) =	**-7.9**	$mg/m^2/day$
BT2-07	0.523	#6	35	0.523	0.522	5	0.548	X Coefficient(s)	-0.001	(high) =	**1.1**	$mg/m^2/day$
BT2-08	0.638	#7	42	0.638	0.637	6	0.544					
BT2-09	0.552	#8	49	0.552	0.551	7	0.540					
BT2-10	0.540	#9	56	0.540	0.539	8	0.536					
BT2-11	0.508	#10	63	0.508	0.507	9	0.532					
BT2-12	0.503	#11	70	0.503	0.501	10	0.528					
								Std Err of Coef.	0.000			
Test #3								Regression Output:				
	0.657	T-#0		0.657				Constant	0.651			
BT3-02	0.657	#1	7	0.657	0.657	0	0.654	Std Err of Y Est	0.080			
BT3-04	0.605	#2	21	0.605	0.602	2	0.660	R Squared	0.015			
BT3-06	0.766	#3	35	0.766	0.759	4	0.665	No. of Observations	6	Flux = 2.6 mg/m^2/day		
BT3-08	0.614	#4	49	0.614	0.604	6	0.671	Degrees of Freedom	4			
BT3-10	0.801	#5	63	0.801	0.787	8	0.677			80% CI (low) =	**-13.3**	$mg/m^2/day$
BT3-12	0.617	#6	70	0.617	0.600	10	0.680	X Coefficient(s)	0.000	(high) =	**18.5**	$mg/m^2/day$
								Std Err of Coef.	0.002			







Print Date: 8/8/2008

BATTELLE MARINE SCIENCES LABORATORY
1529 West Sequim Bay Road
Sequim, WA 98382-9099
360/681-3604

TETRA TECH
METALS IN SEAWATER
(Samples Received 6/3/98)

(concentrations in µg/L - not blank corrected)

MSL Code	Sponsor ID	Sb	As	Cd	Cu	Pb	Mn	Ni	Se	Ag	Tl	Zn
1225-2	BFSD2-BT1-3	0.125	1.25	0.219	1.42	0.159	7.70	0.589	0.568	0.0120	0.0113	8.85
1225-4	BFSD2-BT1-5	0.126	1.16	0.246	1.50	0.146	6.67	0.577	0.521	0.0151	0.0119	8.61
1225-6	BFSD2-BT1-7	0.121	1.18	0.230	1.53	0.200	6.23	0.559	0.488	0.0181	0.0115	8.30
1225-8	BFSD2-BT1-9	0.192	1.14	0.215	2.00	0.216	5.66	0.730	0.468	0.0120	0.0125	8.63
1225-10	BFSD2-BT1-11	0.142	1.10	0.190	1.89	0.149	5.08	0.970	0.452	0.0722	0.0118	7.35
1225-11	BFSD2-BT1-12	0.143	1.15	0.182	1.44	0.203	4.74	0.657	0.450	0.0181	0.0119	6.86
1225-12	BFSD2-BT2-EB	0.0168	0.00728 J	0.0120	0.376	0.0998	0.664 J	0.0522 J	0.0351 J	0.00903	0.000499 J	3.32
1225-13	BFSD2-BT2-SB	0.0248	0.00745 J	0.00750	0.169	4.33	0.689 J	0.0729 J	0.0248 J	0.0120	0.00121	0.984
1225-14	BFSD2-BT2-1	0.117	1.16	0.0752	2.57	0.237	7.80	2.13	0.372	0.00903	0.0109	6.04
1225-15	BFSD2-BT2-2	0.127	1.13	0.0937	1.72	0.128	7.63	0.615	0.519	0.0151	0.0110	6.50
1225-16	BFSD2-BT2-3	0.118	1.16	0.131	1.77	0.137	7.10	0.568	0.461	0.0181	0.0114	5.99
1225-17	BFSD2-BT2-4	0.124	1.14	0.128	1.85	0.188	6.85	0.658	0.410	0.0181	0.0111	7.10
1225-18	BFSD2-BT2-5	0.113	1.12	0.122	1.66	0.141	6.45	0.721	0.405	0.0181	0.0112	8.28
1225-19	BFSD2-BT2-6	0.0770	1.15	0.121	1.73	0.186	6.20	0.618	0.443	0.0151	0.0116	7.17
1225-20	BFSD2-BT2-7	0.0761	1.13	0.114	1.67	0.141	5.96	0.681	0.430	0.0120	0.0122	5.46
1225-21	BFSD2-BT2-8	0.104	1.13	0.108	1.58	0.141	5.84	0.523	0.454	0.0151	0.0114	6.51
1225-22	BFSD2-BT2-9	0.0551	1.09	0.134	1.64	0.159	5.35	0.614	0.427	0.0181	0.0117	7.46
1225-23	BFSD2-BT2-10	0.0783	1.10	0.108	1.52	0.230	5.23	0.617	0.407	0.0181	0.0118	9.35
1225-24	BFSD2-BT2-11	0.0689	1.16	0.0998	1.69	0.144	4.88	0.656	0.418	0.0120	0.0124	5.06
1225-25	BFSD2-BT2-12	0.0807	1.09	0.104	1.69	0.221	4.76	1.13	0.349	0.0120	0.0123	5.96
1225-27	BFSD2-BT3-2	0.0759	1.12	0.0622	1.03	0.108	7.50	0.511	0.453	0.0120	0.0113	2.82
1225-29	BFSD2-BT3-4	0.0750	1.05	0.0679	1.04	0.147	6.76	0.492	0.341	0.00903	0.0118	3.31
1225-31	BFSD2-BT3-6	0.130	1.03	0.0669	1.10	0.123	6.14	0.516	0.441	0.0151	0.0113	3.52
1225-33	BFSD2-BT3-8	0.0867	1.14	0.0643	1.06	0.118	5.78	0.462	0.435	0.0120	0.0121	3.56
1225-35	BFSD2-BT3-10	0.0612	1.12	0.0623	1.33	0.138	5.21	0.474	0.453	0.0120	0.0119	3.71
1225-37	BFSD2-BT3-12	0.125	1.10	0.0670	1.14	0.134	4.80	0.444	0.373	0.0120	0.0112	5.90
BLANKS												
1225-blk r1		0.0158	0.0227 J	0.000444 J	0.0420 J	0.00580 J	0.510 J	0.0165 J	0.0529 J	0.00903	0.00070 J	0.119 J
1225-blk r2		0.0145	0.0180 J	0.000611 J	0.0395 J	0.00800	0.596 J	0.0178 J	0.0212 J	0.00602	0.00054 J	0.140 J
Mean		0.0152	0.0204 J	0.000528 J	0.0407 J	0.00690	0.553 J	0.0171 J	0.0371 J	0.00753	0.00062 J	0.130 J
DETECTION LIMIT		0.01	0.12	0.007	0.076	0.006	0.87	0.08	0.16	0.00532	0.001	0.66

BATTELLE MARINE SCIENCES LABORATORY
1529 West Sequim Bay Road
Sequim, WA 98382-9099
360/681-3604

TETRA TECH
METALS IN SEAWATER
(Samples Received 6/3/98)

(concentrations in µg/L - not blank corrected)

MSL Code	Sponsor ID	Sb	As	Cd	Cu	Pb	Mn	Ni	Se	Ag	Tl	Zn
BLANK SPIKE RESULTS												
Amount Spiked		5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Mean Blank		0.0152	0.0204	0.00053 J	0.0407	0.00690	0.553	0.0171	0.0371	0.00753	0.00062 J	0.130
Blank Spike		3.66	2.98	3.69	4.31	4.60	5.07	4.30	1.26	2.12	4.70	4.61
Amount Recovered		3.64	2.96	3.69	4.27	4.59	4.52	4.29	1.22	2.11	4.69	4.48
Percent Recovery		73% #	59% #	74% #	85%	92%	90%	86%	24% #	42% #	94%	90%
Amount Spiked		5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Mean Blank		0.0152	0.0204	0.00053 J	0.0407	0.00690	0.553	0.0171	0.0371	0.00753	0.00062 J	0.130
Blank Spike Dup		3.84	3.04	3.64	4.38	4.69	5.19	4.53	1.61	2.09	4.87	4.64
Amount Recovered		3.83	3.01	3.63	4.34	4.68	4.64	4.51	1.57	2.08	4.87	4.51
Percent Recovery		77%	60% #	73% #	87%	94%	93%	90%	31% #	42% #	97%	90%
RPD		5%	2%	1%	2%	2%	3%	5%	25%	1%	4%	1%
MATRIX SPIKE RESULTS												
Amount Spiked		5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
1225-24		0.0689	1.16	0.0998	1.69	0.144	4.88	0.656	0.418	0.0120	0.0124	5.06
1225-24 MS		2.48	5.21	4.74	5.99	5.15	9.53	4.84	4.92	4.40	5.20	8.71
Amount Recovered		2.41	4.05	4.64	4.29	5.00	4.66	4.18	4.50	4.39	5.19	3.64
Percent Recovery		48% #	81%	93%	86%	100%	93%	84%	90%	88%	104%	73% #
Amount Spiked		5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
1225-24		0.0689	1.16	0.0998	1.69	0.144	4.88	0.656	0.418	0.0120	0.0124	5.06
1225-24 MSD		3.12	5.30	4.74	5.93	5.17	9.58	4.89	4.97	4.44	5.18	8.56
Amount Recovered		3.05	4.14	4.64	4.24	5.02	4.71	4.24	4.55	4.43	5.17	3.50
Percent Recovery		61% #	83%	93%	85%	100%	94%	85%	91%	89%	103%	70% #
RPD		24%	2%	0%	1%	0%	1%	1%	1%	1%	0%	4%

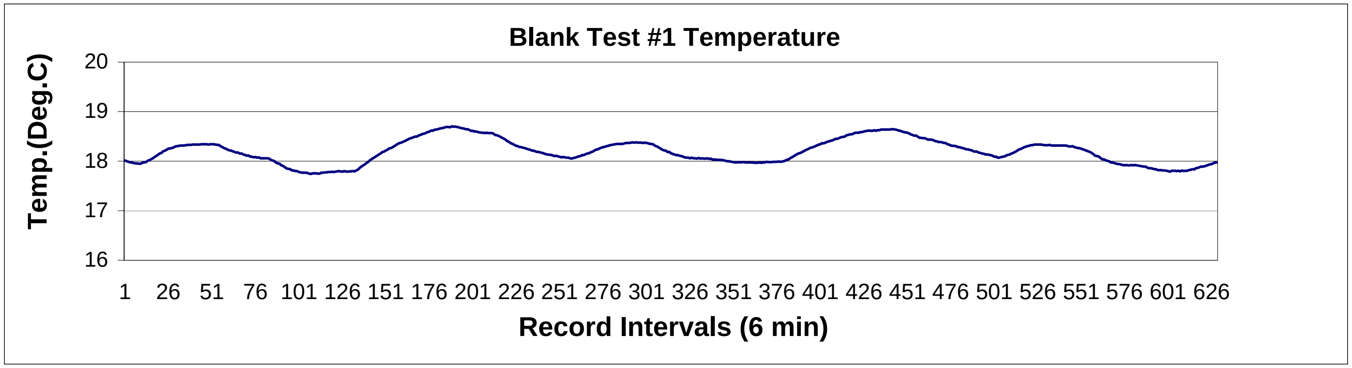
BATTELLE MARINE SCIENCES LABORATORY
1529 West Sequim Bay Road
Sequim, WA 98382-9099
360/681-3604

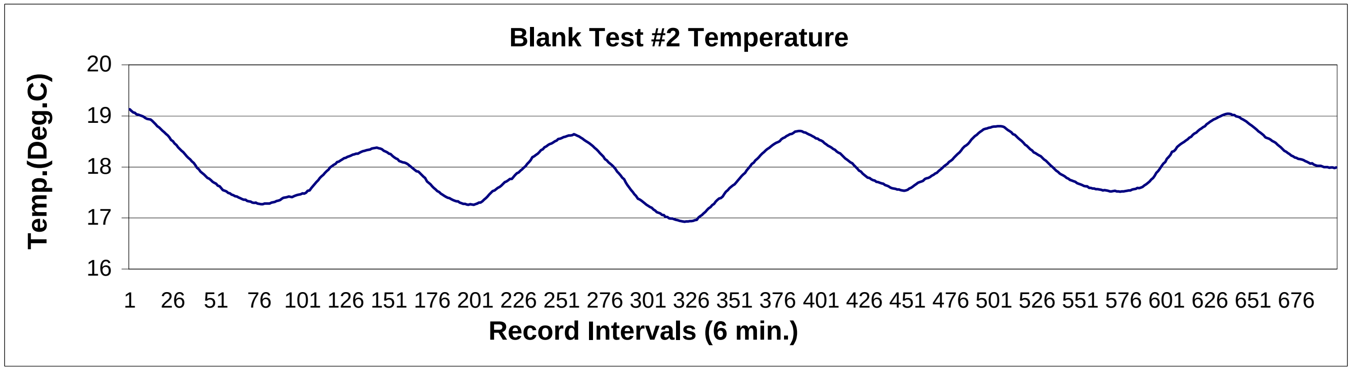
TETRA TECH
METALS IN SEAWATER
(Samples Received 6/3/98)

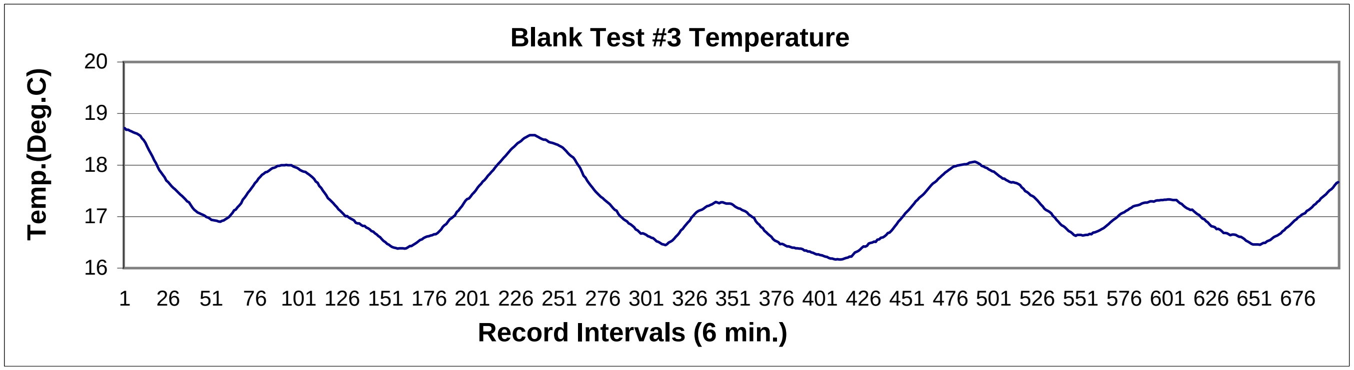
		(concentrations in µg/L - not blank corrected)										
MSL Code	Sponsor ID	Sb	As	Cd	Cu	Pb	Mn	Ni	Se	Ag	Tl	Zn
STANDARD REFERENCE MATERIAL												
cass3 r1		0.139	0.975	0.0339	0.550	0.0230	3.10	0.417	0.441	0.0120	0.0127	1.25
cass3 r2		0.112	0.961	0.0345	0.529	0.0230	3.03	0.400	0.404	0.0120	0.0119	1.21
	certified value	NC	1.09	0.030	0.517	0.0120	2.51	0.386	0.042 r	NC	NC	1.24
	range		±0.07	±0.005	±0.062	±0.004	±0.36	±0.062				±0.25
	percent difference	NA	11%	13%	6%	91% #	23%	8%	NA	NA	NA	1%
		NA	12%	15%	2%	91% #	21%	4%	NA	NA	NA	2%

\# Outside QA limits of ±25%
r Reference value only; not certified
J Value reported is below DL shown
NA Not available/applicable
NC Not certified
RPD Relative percent difference

BFSD 2
Triplicate Blank Tests
Temperature

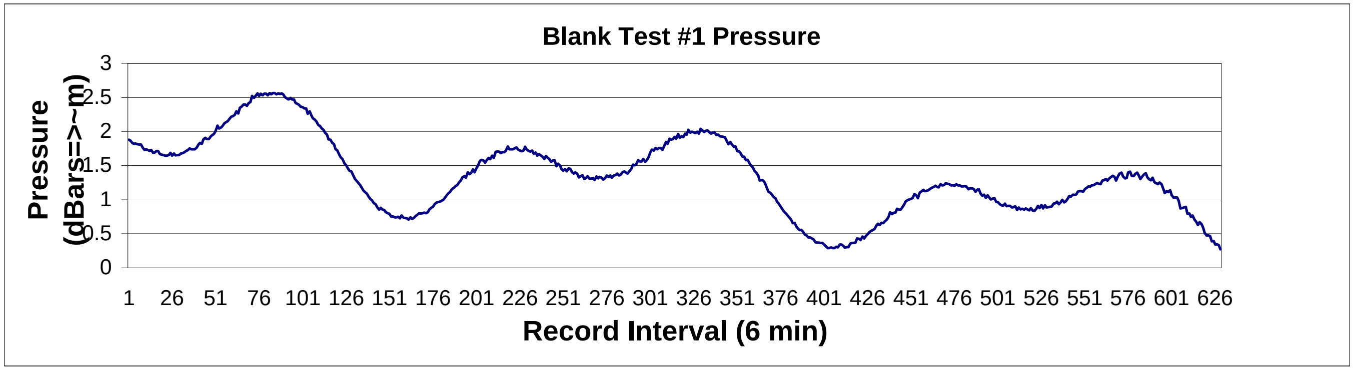


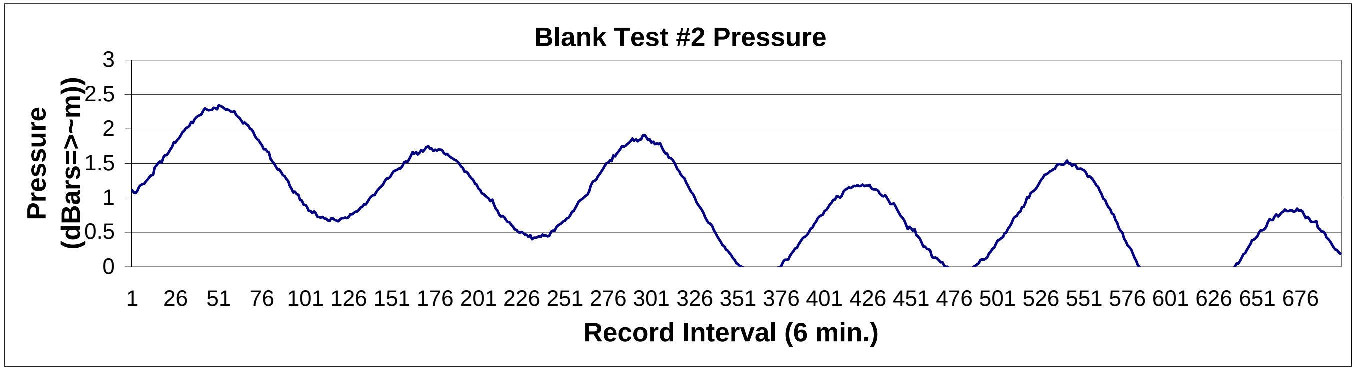


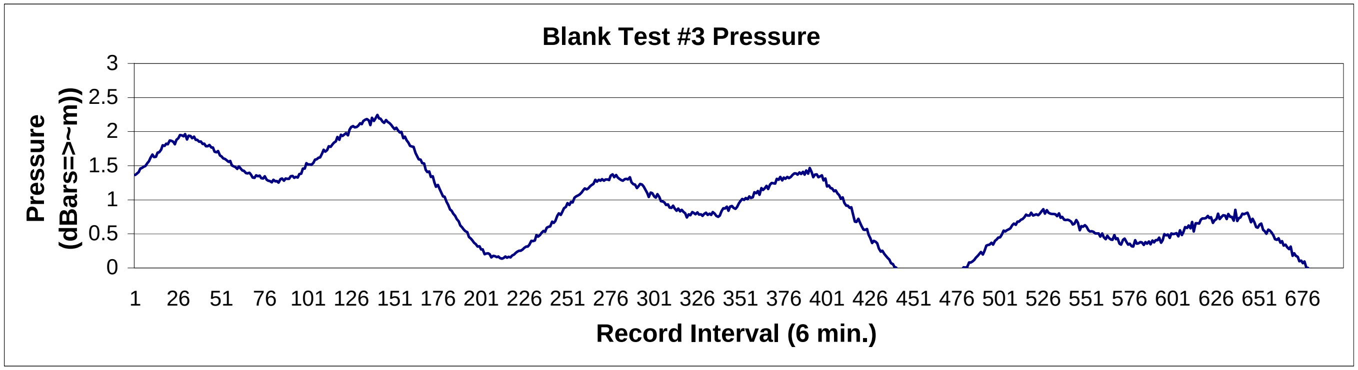


BFSD 2
Triplicate BlankTests
Pressure

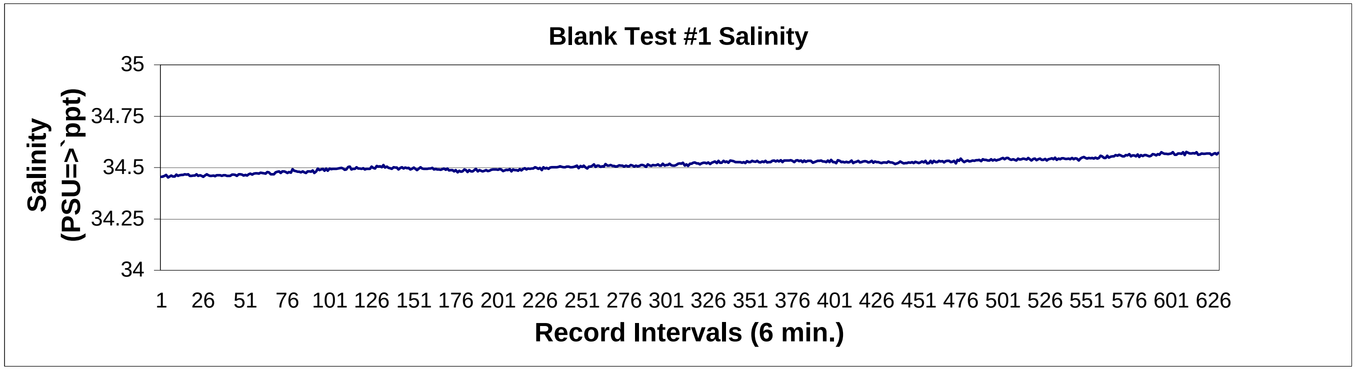
Note: Allow for (faulty) sensor drift
(subsequently corrected)

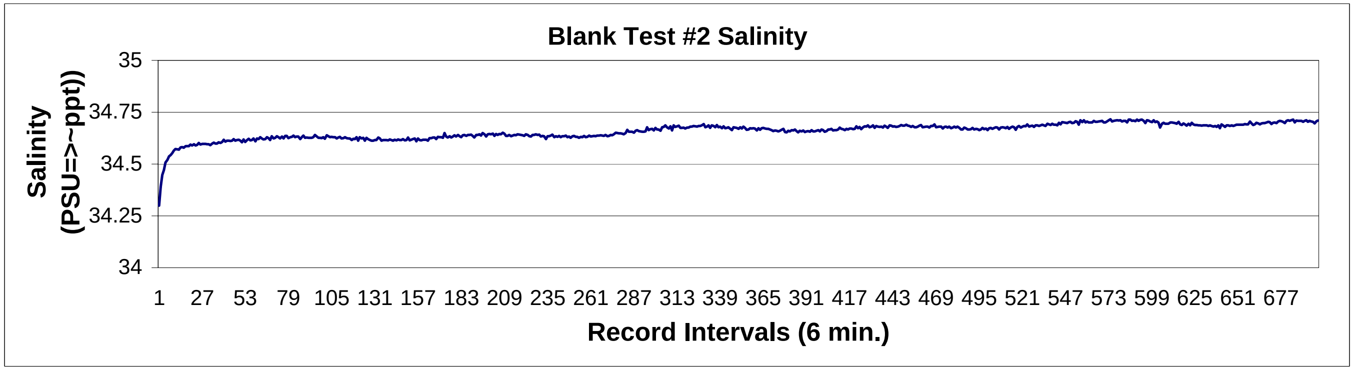


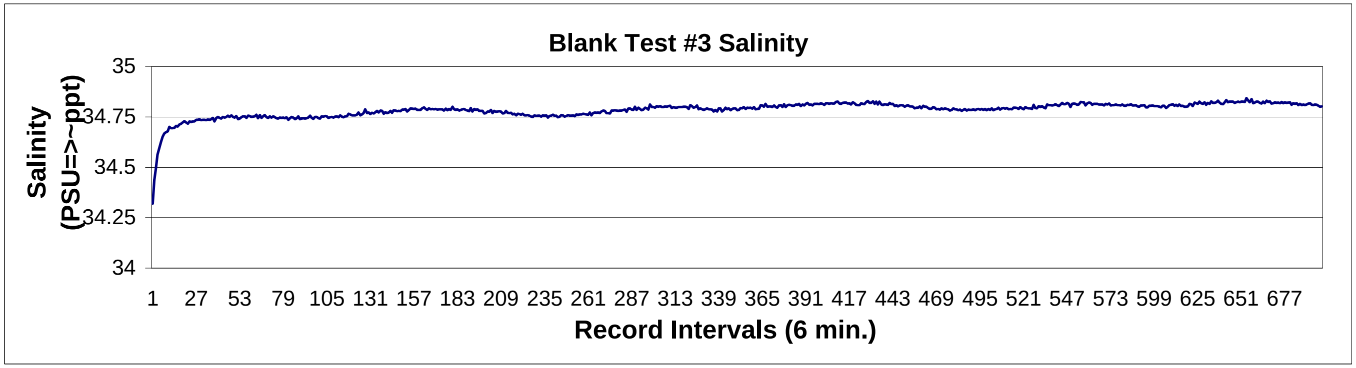




BFSD 2
Triplicate BlankTests
Salinity

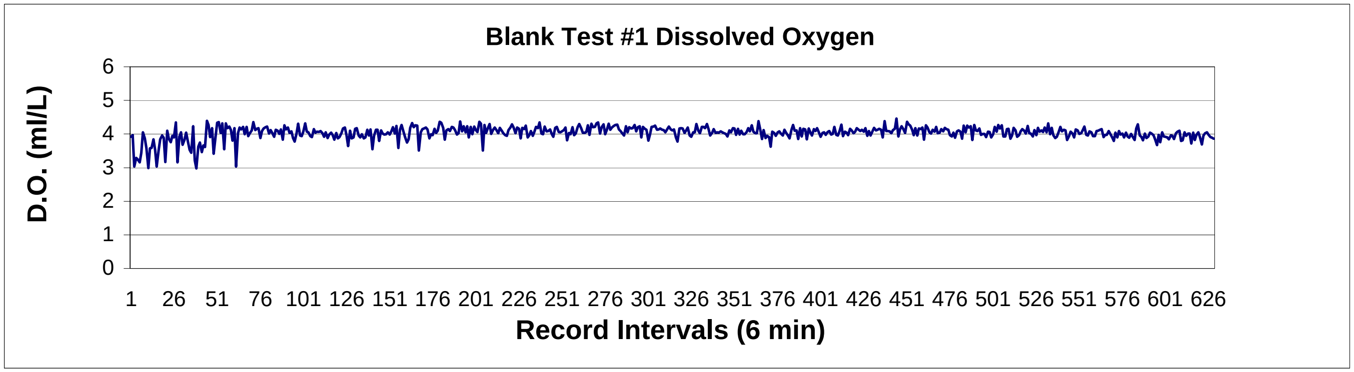


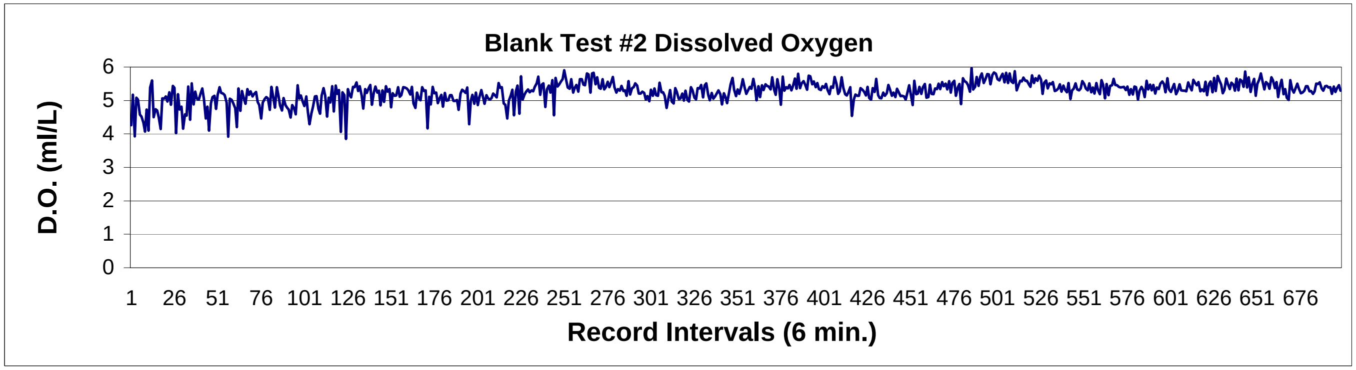


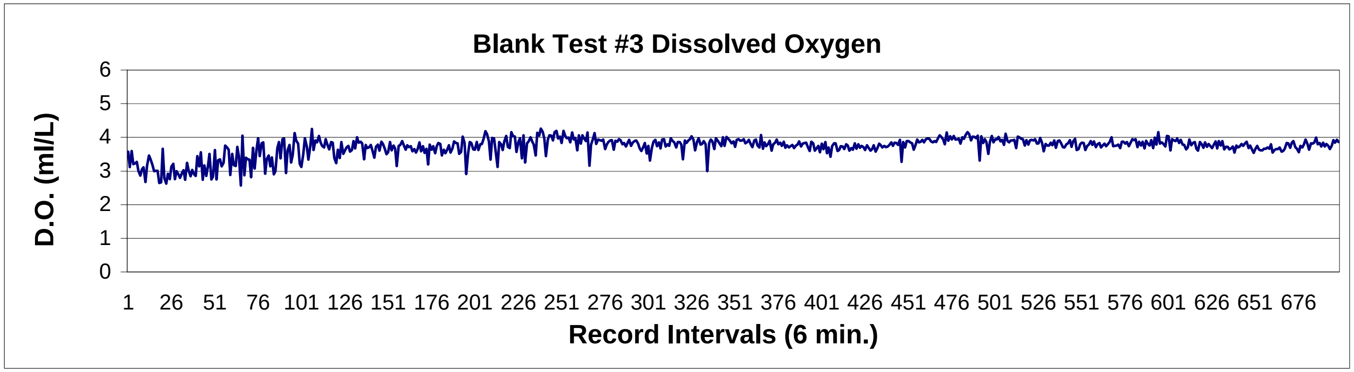


BFSD 2
Triplicate BlankTests
Dissolved Oxygen

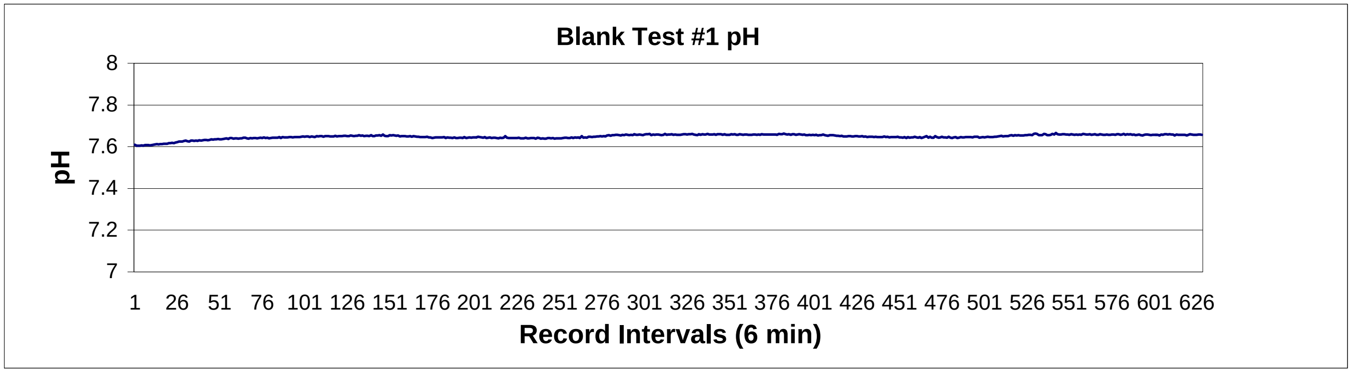
Note: "Noisey" traces due to restricted flow over sensor (subsequently corrected)

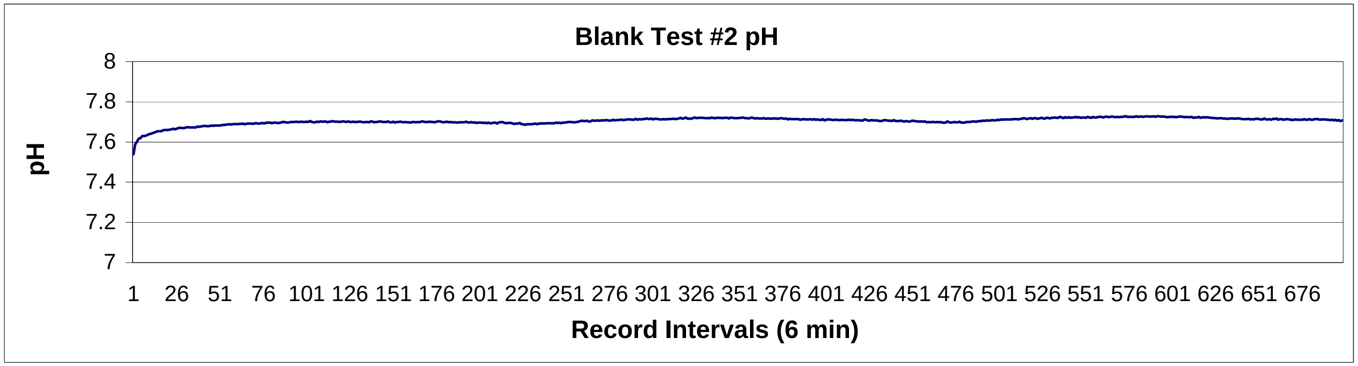


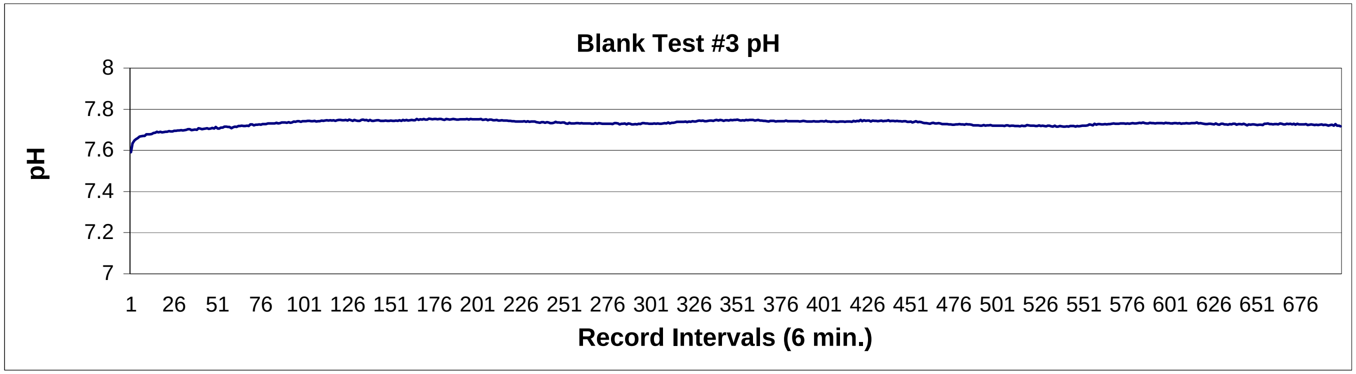




BFSD 2
Triplicate BlankTests
pH







Blank Test #1 Sensor Data

Record No.	Conductivity (mS/cm)	Temperature (Deg. C)	Pressure (dBar)	Salinity (PSU)	CTD Bat. (Vdc)	D.O. (Integer)	pH (Integer)	Date	Time	D.O. (ml/L)	pH (Value)
1	45.276	18.011	1.881	34.455	13.262	2339916	2456346	5/14/1998	14:34:30.70	3.917	7.610
2	45.265	17.998	1.866	34.457	13.312	2346641	2455075	5/14/1998	14:40:31.49	3.963	7.605
3	45.255	17.986	1.834	34.459	13.325	2211156	2455165	5/14/1998	14:46:32.28	3.034	7.605
4	45.248	17.972	1.817	34.464	13.334	2248927	2455032	5/14/1998	14:52:33.07	3.293	7.604
5	45.233	17.971	1.823	34.452	13.337	2241082	2455530	5/14/1998	14:58:33.86	3.239	7.607
6	45.227	17.96	1.813	34.457	13.342	2228945	2455191	5/14/1998	15:04:34.65	3.156	7.605
7	45.225	17.953	1.811	34.461	13.342	2270518	2455686	5/14/1998	15:10:35.44	3.441	7.607
8	45.222	17.955	1.808	34.457	13.344	2359142	2455926	5/14/1998	15:16:36.23	4.049	7.608
9	45.212	17.947	1.769	34.456	13.309	2333397	2455695	5/14/1998	15:22:37.02	3.873	7.607
10	45.223	17.946	1.731	34.466	13.334	2290483	2455503	5/14/1998	15:28:37.81	3.578	7.606
11	45.236	17.967	1.738	34.459	13.339	2204401	2455996	5/14/1998	15:34:38.60	2.987	7.609
12	45.245	17.971	1.73	34.463	13.34	2289578	2456336	5/14/1998	15:40:39.39	3.572	7.610
13	45.257	17.982	1.715	34.464	13.342	2291758	2456695	5/14/1998	15:46:40.18	3.587	7.612
14	45.279	18.004	1.73	34.464	13.343	2328554	2456877	5/14/1998	15:52:40.97	3.839	7.612
15	45.295	18.017	1.686	34.467	13.345	2284263	2456437	5/14/1998	15:58:41.76	3.535	7.610
16	45.317	18.041	1.69	34.465	13.345	2211735	2456885	5/14/1998	16:04:42.55	3.038	7.612
17	45.335	18.057	1.715	34.467	13.346	2279745	2456945	5/14/1998	16:10:43.34	3.504	7.613
18	45.356	18.087	1.709	34.46	13.346	2328233	2457334	5/14/1998	16:16:44.13	3.837	7.614
19	45.375	18.106	1.668	34.46	13.345	2346193	2457414	5/14/1998	16:22:44.92	3.960	7.615
20	45.401	18.131	1.661	34.461	13.348	2335558	2457412	5/14/1998	16:28:45.71	3.887	7.615
21	45.422	18.152	1.657	34.461	13.346	2230192	2458049	5/14/1998	16:34:46.50	3.164	7.617
22	45.447	18.17	1.646	34.467	13.347	2365600	2458046	5/14/1998	16:40:47.29	4.094	7.617
23	45.47	18.203	1.647	34.459	13.347	2332186	2458176	5/14/1998	16:46:48.08	3.864	7.618
24	45.488	18.216	1.654	34.463	13.347	2316255	2458154	5/14/1998	16:52:48.87	3.755	7.618
25	45.502	18.235	1.687	34.459	13.346	2343800	2458859	5/14/1998	16:58:49.66	3.944	7.621
26	45.511	18.249	1.646	34.455	13.346	2337673	2458981	5/14/1998	17:04:50.45	3.902	7.621
27	45.528	18.258	1.676	34.461	13.346	2402169	2459741	5/14/1998	17:10:51.24	4.345	7.625
28	45.541	18.263	1.648	34.468	13.345	2229313	2459899	5/14/1998	17:16:52.03	3.158	7.625
29	45.551	18.28	1.656	34.463	13.328	2341141	2459764	5/14/1998	17:22:52.82	3.926	7.625
30	45.563	18.295	1.657	34.46	13.336	2359001	2460457	5/14/1998	17:28:53.61	4.048	7.628
31	45.566	18.3	1.68	34.459	13.34	2305131	2460661	5/14/1998	17:34:54.40	3.679	7.629
32	45.577	18.309	1.682	34.461	13.339	2327314	2460177	5/14/1998	17:40:55.19	3.831	7.627
33	45.579	18.314	1.698	34.458	13.34	2357361	2459776	5/14/1998	17:46:55.98	4.037	7.625
34	45.586	18.316	1.714	34.462	13.339	2323358	2460836	5/14/1998	17:52:56.77	3.804	7.629
35	45.587	18.318	1.726	34.462	13.339	2282749	2460833	5/14/1998	17:58:57.56	3.525	7.629
36	45.593	18.322	1.752	34.463	13.34	2271057	2460620	5/14/1998	18:04:58.35	3.445	7.629
37	45.593	18.327	1.739	34.459	13.34	2386149	2460929	5/14/1998	18:10:59.14	4.235	7.630
38	45.6	18.329	1.737	34.463	13.339	2237429	2460319	5/14/1998	18:16:59.93	3.214	7.627
39	45.6	18.329	1.739	34.463	13.338	2202846	2460996	5/14/1998	18:23:00.72	2.977	7.630
40	45.602	18.336	1.763	34.459	13.339	2296880	2460929	5/14/1998	18:29:01.51	3.622	7.630
41	45.605	18.338	1.804	34.46	13.339	2314948	2461308	5/14/1998	18:35:02.30	3.746	7.632
42	45.604	18.336	1.831	34.46	13.338	2273005	2461633	5/14/1998	18:41:03.09	3.458	7.633
43	45.607	18.333	1.82	34.466	13.336	2302834	2461552	5/14/1998	18:47:03.88	3.663	7.633
44	45.609	18.335	1.883	34.465	13.337	2295581	2461217	5/14/1998	18:53:04.67	3.613	7.631
45	45.612	18.339	1.906	34.464	13.337	2409399	2461591	5/14/1998	18:59:05.46	4.394	7.633
46	45.611	18.345	1.888	34.459	13.336	2391571	2462197	5/14/1998	19:05:06.25	4.272	7.635
47	45.616	18.339	1.889	34.468	13.336	2338360	2461855	5/14/1998	19:11:07.04	3.907	7.634
48	45.617	18.341	1.922	34.468	13.336	2377738	2462122	5/14/1998	19:17:07.83	4.177	7.635
49	45.611	18.338	1.946	34.465	13.338	2266786	2462090	5/14/1998	19:23:08.62	3.415	7.635
50	45.607	18.339	1.966	34.461	13.336	2340669	2462577	5/14/1998	19:29:09.41	3.922	7.637
51	45.612	18.339	2.004	34.464	13.335	2401428	2462098	5/14/1998	19:35:10.20	4.339	7.635
52	45.608	18.34	2.084	34.461	13.335	2403924	2462223	5/14/1998	19:41:10.99	4.357	7.635
53	45.61	18.335	2.042	34.467	13.337	2356018	2462593	5/14/1998	19:47:11.78	4.028	7.637
54	45.606	18.326	2.059	34.47	13.333	2397528	2462807	5/14/1998	19:53:12.57	4.313	7.638
55	45.6	18.327	2.081	34.465	13.333	2285816	2463198	5/14/1998	19:59:13.36	3.546	7.640
56	45.584	18.303	2.117	34.471	13.333	2398260	2462569	5/14/1998	20:05:14.15	4.318	7.637
57	45.567	18.285	2.137	34.472	13.332	2377051	2463576	5/14/1998	20:11:14.94	4.172	7.641
58	45.544	18.263	2.153	34.472	13.331	2383918	2463667	5/14/1998	20:17:15.73	4.219	7.642
59	45.531	18.25	2.191	34.471	13.331	2368433	2463074	5/14/1998	20:23:16.52	4.113	7.639
60	45.52	18.235	2.219	34.475	13.331	2323805	2463263	5/14/1998	20:29:17.31	3.807	7.640
61	45.504	18.221	2.226	34.473	13.331	2376991	2463289	5/14/1998	20:35:18.10	4.172	7.640
62	45.493	18.21	2.244	34.472	13.333	2210825	2463077	5/14/1998	20:41:18.89	3.031	7.639
63	45.48	18.2	2.297	34.47	13.33	2355678	2463360	5/14/1998	20:47:19.68	4.025	7.640
64	45.477	18.187	2.263	34.478	13.33	2379611	2463320	5/14/1998	20:53:20.47	4.190	7.640
65	45.465	18.176	2.349	34.476	13.331	2371687	2464053	5/14/1998	20:59:21.26	4.135	7.643
66	45.452	18.173	2.369	34.468	13.327	2383050	2464100	5/14/1998	21:05:22.05	4.213	7.644
67	45.437	18.158	2.397	34.468	13.327	2351063	2463189	5/14/1998	21:11:22.84	3.994	7.640
68	45.43	18.152	2.397	34.467	13.326	2383023	2463037	5/14/1998	21:17:23.63	4.213	7.639
69	45.422	18.133	2.375	34.477	13.326	2343310	2463752	5/14/1998	21:23:24.42	3.941	7.642
70	45.417	18.126	2.416	34.479	13.328	2355325	2463448	5/14/1998	21:29:25.21	4.023	7.641
71	45.406	18.112	2.431	34.481	13.327	2367457	2463585	5/14/1998	21:35:26.00	4.106	7.641
72	45.401	18.116	2.52	34.473	13.324	2403576	2463594	5/14/1998	21:42:08.00	4.354	7.641
73	45.388	18.093	2.496	34.481	13.324	2369041	2463392	5/14/1998	21:48:08.79	4.117	7.641
74	45.387	18.091	2.521	34.482	13.323	2373998	2463809	5/14/1998	21:54:09.58	4.151	7.642
75	45.37	18.078	2.559	34.478	13.324	2377182	2463890	5/14/1998	22:00:10.37	4.173	7.643
76	45.371	18.084	2.524	34.474	13.324	2334801	2463724	5/14/1998	22:06:11.16	3.882	7.642
77	45.365	18.074	2.555	34.478	13.322	2365159	2464469	5/14/1998	22:12:11.95	4.091	7.645
78	45.363	18.076	2.533	34.475	13.323	2375688	2463809	5/14/1998	22:18:12.74	4.163	7.642
79	45.362	18.055	2.555	34.492	13.323	2381254	2464032	5/14/1998	22:24:13.53	4.201	7.643
80	45.357	18.059	2.556	34.484	13.325	2384078	2463464	5/14/1998	22:30:14.32	4.220	7.641
81	45.354	18.057	2.53	34.483	13.322	2353772	2463593	5/14/1998	22:36:15.11	4.012	7.641
82	45.349	18.055	2.563	34.48	13.321	2368779	2463860	5/14/1998	22:42:15.90	4.115	7.643
83	45.348	18.056	2.543	34.479	13.321	2356085	2463896	5/14/1998	22:48:16.69	4.028	7.643
84	45.342	18.053	2.566	34.476	13.32	2340172	2464056	5/14/1998	22:54:17.48	3.919	7.643
85	45.323	18.027	2.562	34.482	13.32	2370278	2463957	5/14/1998	23:00:18.27	4.126	7.643
86	45.306	18.016	2.546	34.477	13.319	2366424	2464550	5/14/1998	23:06:19.06	4.099	7.646
87	45.287	17.999	2.558	34.474	13.318	2352180	2463720	5/14/1998	23:12:19.85	4.001	7.642
88	45.264	17.968	2.552	34.481	13.318	2372135	2464649	5/14/1998	23:18:20.64	4.138	7.646
89	45.252	17.955	2.558	34.482	13.318	2327818	2464429	5/14/1998	23:24:21.43	3.834	7.645
90	45.24	17.946	2.539	34.48	13.319	2389883	2464399	5/14/1998	23:30:22.22	4.260	7.645
91	45.22	17.917	2.504	34.486	13.319	2371560	2464360	5/14/1998	23:36:23.01	4.134	7.645

Record No.	Conductivity (mS/cm)	Temperature (Deg. C)	Pressure (dBar)	Salinity (PSU)	CTD Bat. (Vdc)	D.O. (Integer)	pH (Integer)	Date	Time	D.O. (ml/L)	pH (Value)
92	45.193	17.905	2.486	34.474	13.316	2380525	2464586	5/14/1998	23:42:23.80	4.196	7.646
93	45.174	17.876	2.47	34.482	13.315	2356383	2464819	5/14/1998	23:48:24.59	4.030	7.647
94	45.165	17.852	2.495	34.495	13.316	2363233	2464439	5/14/1998	23:54:25.38	4.077	7.645
95	45.152	17.847	2.471	34.488	13.315	2334303	2464571	5/15/1998	00:00:26.17	3.879	7.646
96	45.145	17.836	2.471	34.491	13.315	2318677	2464603	5/15/1998	00:06:26.96	3.772	7.646
97	45.126	17.815	2.42	34.493	13.314	2354618	2464559	5/15/1998	00:12:27.75	4.018	7.646
98	45.112	17.811	2.403	34.484	13.315	2396418	2464540	5/15/1998	00:18:28.54	4.305	7.645
99	45.111	17.797	2.39	34.495	13.313	2345937	2465214	5/15/1998	00:24:29.33	3.959	7.648
100	45.1	17.797	2.364	34.485	13.314	2343263	2465354	5/15/1998	00:30:30.12	3.940	7.649
101	45.095	17.781	2.36	34.496	13.314	2361929	2464998	5/15/1998	00:36:30.91	4.068	7.647
102	45.085	17.776	2.338	34.492	13.312	2397693	2465248	5/15/1998	00:42:31.70	4.314	7.649
103	45.082	17.77	2.339	34.494	13.313	2361991	2465327	5/15/1998	00:48:32.49	4.069	7.649
104	45.077	17.766	2.26	34.493	13.311	2359765	2464850	5/15/1998	00:54:33.28	4.054	7.647
105	45.078	17.765	2.297	34.494	13.311	2343112	2465278	5/15/1998	01:00:34.07	3.939	7.649
106	45.073	17.759	2.24	34.495	13.31	2339118	2465036	5/15/1998	01:06:34.86	3.912	7.648
107	45.067	17.75	2.192	34.497	13.309	2373443	2464837	5/15/1998	01:12:35.65	4.147	7.647
108	45.06	17.743	2.175	34.498	13.309	2358277	2465788	5/15/1998	01:18:36.44	4.043	7.651
109	45.069	17.754	2.147	34.495	13.309	2361881	2465250	5/15/1998	01:24:37.23	4.068	7.649
110	45.061	17.754	2.095	34.489	13.308	2360513	2465788	5/15/1998	01:30:38.02	4.059	7.651
111	45.064	17.755	2.082	34.491	13.308	2365125	2465730	5/15/1998	01:36:38.81	4.090	7.651
112	45.071	17.748	2.043	34.503	13.308	2354717	2465046	5/15/1998	01:42:39.60	4.019	7.648
113	45.076	17.75	2.024	34.505	13.307	2339792	2465843	5/15/1998	01:48:40.39	3.916	7.651
114	45.074	17.767	1.981	34.49	13.307	2359431	2465605	5/15/1998	01:54:41.18	4.051	7.650
115	45.077	17.765	1.954	34.493	13.308	2334336	2465603	5/15/1998	02:00:41.97	3.879	7.650
116	45.085	17.773	1.883	34.493	13.308	2349904	2465524	5/15/1998	02:06:42.76	3.986	7.650
117	45.092	17.771	1.879	34.501	13.307	2357965	2465475	5/15/1998	02:12:43.55	4.041	7.650
118	45.096	17.781	1.838	34.496	13.307	2346763	2465589	5/15/1998	02:18:44.34	3.964	7.650
119	45.096	17.782	1.815	34.495	13.306	2327530	2466033	5/15/1998	02:24:45.13	3.832	7.652
120	45.095	17.785	1.74	34.493	13.307	2356530	2465461	5/15/1998	02:30:45.92	4.031	7.649
121	45.099	17.783	1.727	34.497	13.308	2333205	2465944	5/15/1998	02:36:46.71	3.871	7.652
122	45.093	17.785	1.662	34.491	13.306	2337882	2465861	5/15/1998	02:42:47.50	3.903	7.651
123	45.106	17.795	1.62	34.494	13.305	2355699	2465839	5/15/1998	02:48:48.29	4.026	7.651
124	45.108	17.797	1.596	34.493	13.306	2375615	2466033	5/15/1998	02:54:49.08	4.162	7.652
125	45.107	17.795	1.538	34.494	13.304	2380729	2466074	5/15/1998	03:00:49.87	4.197	7.652
126	45.113	17.79	1.505	34.504	13.303	2346873	2465608	5/15/1998	03:06:50.66	3.965	7.650
127	45.117	17.799	1.463	34.498	13.303	2299817	2465916	5/15/1998	03:12:51.45	3.642	7.651
128	45.108	17.795	1.426	34.496	13.302	2365956	2466497	5/15/1998	03:18:52.24	4.096	7.654
129	45.115	17.786	1.414	34.508	13.302	2333427	2466179	5/15/1998	03:24:53.03	3.873	7.653
130	45.115	17.791	1.368	34.504	13.302	2337033	2465739	5/15/1998	03:30:53.82	3.898	7.651
131	45.121	17.793	1.31	34.507	13.303	2374985	2466073	5/15/1998	03:36:54.61	4.158	7.652
132	45.125	17.803	1.281	34.502	13.302	2376677	2466292	5/15/1998	03:42:55.40	4.170	7.653
133	45.126	17.792	1.249	34.512	13.302	2345688	2466780	5/15/1998	03:48:56.19	3.957	7.655
134	45.133	17.814	1.217	34.5	13.301	2336899	2466162	5/15/1998	03:54:56.98	3.897	7.653
135	45.148	17.825	1.183	34.504	13.301	2351237	2466577	5/15/1998	04:00:57.77	3.995	7.654
136	45.178	17.863	1.134	34.498	13.303	2333080	2465691	5/15/1998	04:06:58.56	3.870	7.650
137	45.205	17.891	1.111	34.497	13.303	2336919	2466221	5/15/1998	04:12:59.35	3.897	7.653
138	45.224	17.913	1.089	34.494	13.303	2371025	2466294	5/15/1998	04:19:00.14	4.131	7.653
139	45.257	17.937	1.044	34.502	13.303	2345181	2465861	5/15/1998	04:25:00.93	3.953	7.651
140	45.285	17.968	1.008	34.5	13.301	2372030	2466755	5/15/1998	04:31:01.72	4.138	7.655
141	45.305	17.988	0.987	34.5	13.301	2285279	2465932	5/15/1998	04:37:02.51	3.542	7.652
142	45.327	18.02	0.95	34.491	13.302	2344166	2465843	5/15/1998	04:43:44.53	3.946	7.651
143	45.362	18.048	0.933	34.498	13.3	2369962	2466366	5/15/1998	04:49:45.32	4.123	7.653
144	45.381	18.062	0.892	34.502	13.3	2369947	2466500	5/15/1998	04:55:46.11	4.123	7.654
145	45.399	18.088	0.855	34.495	13.299	2322085	2466747	5/15/1998	05:01:46.90	3.795	7.655
146	45.427	18.111	0.882	34.5	13.299	2368270	2466240	5/15/1998	05:07:47.69	4.112	7.653
147	45.446	18.133	0.855	34.497	13.299	2353575	2467488	5/15/1998	05:13:48.48	4.011	7.658
148	45.468	18.154	0.849	34.499	13.3	2350109	2466098	5/15/1998	05:19:49.27	3.987	7.652
149	45.482	18.179	0.817	34.49	13.299	2351218	2465947	5/15/1998	05:25:50.06	3.995	7.652
150	45.501	18.194	0.803	34.493	13.3	2359344	2465720	5/15/1998	05:31:50.85	4.051	7.651
151	45.526	18.21	0.79	34.5	13.298	2349084	2466761	5/15/1998	05:37:51.64	3.980	7.655
152	45.543	18.234	0.749	34.494	13.299	2362851	2466357	5/15/1998	05:43:52.43	4.075	7.653
153	45.561	18.261	0.757	34.488	13.298	2381029	2466728	5/15/1998	05:49:53.22	4.199	7.655
154	45.574	18.266	0.74	34.495	13.298	2353587	2466647	5/15/1998	05:55:54.01	4.011	7.655
155	45.598	18.282	0.741	34.501	13.298	2386931	2466048	5/15/1998	06:01:54.80	4.240	7.652
156	45.612	18.303	0.751	34.496	13.298	2291650	2466400	5/15/1998	06:07:55.59	3.586	7.654
157	45.634	18.327	0.727	34.494	13.299	2371093	2465348	5/15/1998	06:13:56.38	4.131	7.649
158	45.654	18.347	0.769	34.494	13.298	2391363	2465810	5/15/1998	06:19:57.17	4.270	7.651
159	45.672	18.365	0.735	34.493	13.299	2362448	2465915	5/15/1998	06:25:57.96	4.072	7.651
160	45.687	18.377	0.729	34.496	13.298	2338958	2465723	5/15/1998	06:31:58.75	3.911	7.651
161	45.702	18.394	0.726	34.496	13.299	2314425	2465538	5/15/1998	06:37:59.54	3.742	7.650
162	45.72	18.408	0.708	34.498	13.299	2328691	2465559	5/15/1998	06:44:00.33	3.840	7.650
163	45.732	18.429	0.741	34.491	13.298	2379082	2465707	5/15/1998	06:50:01.12	4.186	7.651
164	45.748	18.443	0.719	34.493	13.298	2399845	2465226	5/15/1998	06:56:01.91	4.329	7.648
165	45.762	18.459	0.731	34.491	13.297	2380967	2465836	5/15/1998	07:02:02.70	4.199	7.651
166	45.772	18.47	0.759	34.491	13.297	2390271	2465550	5/15/1998	07:08:03.49	4.263	7.650
167	45.786	18.486	0.777	34.489	13.297	2388876	2465017	5/15/1998	07:14:04.28	4.253	7.648
168	45.802	18.497	0.801	34.492	13.297	2280680	2465085	5/15/1998	07:20:05.07	3.511	7.648
169	45.808	18.5	0.799	34.496	13.296	2359304	2464679	5/15/1998	07:26:05.86	4.050	7.646
170	45.824	18.524	0.801	34.489	13.297	2372525	2464574	5/15/1998	07:32:06.65	4.141	7.646
171	45.835	18.527	0.809	34.496	13.295	2375619	2464652	5/15/1998	07:38:07.44	4.162	7.646
172	45.846	18.549	0.8	34.486	13.295	2380342	2464870	5/15/1998	07:44:08.23	4.195	7.647
173	45.857	18.557	0.816	34.488	13.295	2371967	2465125	5/15/1998	07:50:09.02	4.137	7.648
174	45.867	18.569	0.86	34.487	13.296	2333301	2464295	5/15/1998	07:56:09.81	3.872	7.644
175	45.879	18.589	0.882	34.481	13.295	2351599	2464428	5/15/1998	08:02:10.60	3.997	7.645
176	45.892	18.593	0.895	34.488	13.295	2346469	2463816	5/15/1998	08:08:11.39	3.962	7.642
177	45.903	18.618	0.937	34.477	13.294	2374377	2463877	5/15/1998	08:14:12.18	4.154	7.643
178	45.911	18.616	0.956	34.485	13.295	2356857	2464421	5/15/1998	08:20:12.97	4.034	7.645
179	45.919	18.631	0.966	34.479	13.294	2366693	2464477	5/15/1998	08:26:13.76	4.101	7.645
180	45.931	18.64	0.97	34.482	13.293	2405428	2464468	5/15/1998	08:32:14.55	4.367	7.645
181	45.947	18.645	0.984	34.491	13.293	2400302	2464281	5/15/1998	08:38:15.34	4.332	7.644
182	45.958	18.661	0.997	34.487	13.276	2378810	2464468	5/15/1998	08:44:16.14	4.184	7.645
183	45.952	18.666	1.029	34.478	13.257	2326999	2464612	5/15/1998	08:50:16.93	3.829	7.646
184	45.971	18.673	1.067	34.488	13.27	2367434	2463728	5/15/1998	08:56:17.72	4.106	7.642
185	45.972	18.682	1.095	34.481	13.276	2373371	2464243	5/15/1998	09:02:18.51	4.147	7.644

Record No.	Conductivity (mS/cm)	Temperature (Deg. C)	Pressure (dBar)	Salinity (PSU)	CTD Bat. (Vdc)	D.O. (Integer)	pH (Integer)	Date	Time	D.O. (ml/L)	pH (Value)
186	45.98	18.691	1.115	34.481	13.281	2364539	2464082	5/15/1998	09:08:19.30	4.086	7.644
187	45.985	18.688	1.156	34.487	13.28	2383525	2464173	5/15/1998	09:14:20.09	4.217	7.644
188	45.992	18.687	1.172	34.494	13.282	2380216	2463707	5/15/1998	09:20:20.88	4.194	7.642
189	45.992	18.703	1.202	34.481	13.28	2368968	2464278	5/15/1998	09:26:21.67	4.117	7.644
190	45.992	18.694	1.213	34.488	13.283	2350019	2463640	5/15/1998	09:32:22.46	3.987	7.642
191	45.987	18.694	1.254	34.484	13.28	2354642	2463795	5/15/1998	09:38:23.25	4.018	7.642
192	45.983	18.692	1.282	34.482	13.28	2406127	2463927	5/15/1998	09:44:24.04	4.372	7.643
193	45.976	18.682	1.325	34.484	13.282	2364024	2464092	5/15/1998	09:50:24.83	4.083	7.644
194	45.972	18.674	1.347	34.488	13.283	2385935	2463686	5/15/1998	09:56:25.62	4.233	7.642
195	45.96	18.667	1.324	34.483	13.28	2358993	2464565	5/15/1998	10:02:26.41	4.048	7.646
196	45.952	18.657	1.4	34.485	13.282	2385743	2463581	5/15/1998	10:08:27.20	4.232	7.641
197	45.948	18.648	1.374	34.489	13.28	2337293	2464040	5/15/1998	10:14:27.99	3.899	7.643
198	45.943	18.642	1.397	34.49	13.281	2382243	2464224	5/15/1998	10:20:28.78	4.208	7.644
199	45.935	18.633	1.442	34.491	13.28	2350789	2464025	5/15/1998	10:26:29.57	3.992	7.643
200	45.918	18.616	1.4	34.491	13.281	2383707	2464502	5/15/1998	10:32:30.36	4.218	7.645
201	45.914	18.614	1.461	34.489	13.28	2369711	2464506	5/15/1998	10:38:31.15	4.122	7.645
202	45.907	18.603	1.499	34.492	13.28	2361019	2464312	5/15/1998	10:44:31.94	4.062	7.645
203	45.898	18.597	1.57	34.49	13.28	2404815	2464943	5/15/1998	10:50:32.73	4.363	7.647
204	45.882	18.589	1.586	34.483	13.28	2396909	2464743	5/15/1998	10:56:33.52	4.308	7.646
205	45.878	18.581	1.573	34.486	13.279	2280660	2464190	5/15/1998	11:02:34.31	3.511	7.644
206	45.876	18.576	1.54	34.489	13.279	2391740	2464058	5/15/1998	11:08:35.10	4.273	7.643
207	45.87	18.572	1.58	34.487	13.278	2356241	2464542	5/15/1998	11:14:35.89	4.029	7.646
208	45.871	18.567	1.611	34.492	13.278	2378496	2463580	5/15/1998	11:20:36.68	4.182	7.641
209	45.864	18.572	1.593	34.482	13.278	2395631	2463980	5/15/1998	11:26:37.47	4.300	7.643
210	45.867	18.566	1.643	34.49	13.277	2352619	2464314	5/15/1998	11:32:38.26	4.004	7.645
211	45.868	18.57	1.614	34.487	13.277	2369975	2463766	5/15/1998	11:38:39.05	4.124	7.642
212	45.864	18.565	1.7	34.488	13.276	2379839	2464065	5/15/1998	11:45:21.07	4.191	7.643
213	45.851	18.556	1.707	34.484	13.276	2367463	2464065	5/15/1998	11:51:21.86	4.106	7.643
214	45.832	18.529	1.705	34.492	13.276	2354682	2463791	5/15/1998	11:57:22.65	4.019	7.642
215	45.82	18.523	1.683	34.486	13.276	2378706	2463284	5/15/1998	12:03:23.44	4.184	7.640
216	45.814	18.508	1.696	34.493	13.277	2366231	2463930	5/15/1998	12:09:24.23	4.098	7.643
217	45.798	18.488	1.698	34.497	13.274	2355692	2463649	5/15/1998	12:15:25.02	4.026	7.642
218	45.775	18.473	1.719	34.49	13.274	2346827	2463915	5/15/1998	12:21:25.81	3.965	7.643
219	45.758	18.449	1.779	34.496	13.272	2344638	2465705	5/15/1998	12:27:26.60	3.950	7.651
220	45.737	18.43	1.737	34.494	13.272	2368711	2464033	5/15/1998	12:33:27.39	4.115	7.643
221	45.712	18.403	1.74	34.496	13.273	2380056	2463707	5/15/1998	12:39:28.18	4.193	7.642
222	45.695	18.387	1.74	34.495	13.272	2393889	2463532	5/15/1998	12:45:28.97	4.288	7.641
223	45.677	18.361	1.753	34.501	13.271	2379914	2463815	5/15/1998	12:51:29.76	4.192	7.642
224	45.661	18.348	1.769	34.499	13.27	2355802	2463778	5/15/1998	12:57:30.55	4.026	7.642
225	45.637	18.331	1.736	34.493	13.27	2380692	2463615	5/15/1998	13:03:31.34	4.197	7.642
226	45.625	18.312	1.721	34.498	13.269	2375283	2463711	5/15/1998	13:09:32.13	4.160	7.642
227	45.605	18.305	1.709	34.488	13.269	2332420	2464032	5/15/1998	13:15:32.92	3.866	7.643
228	45.6	18.283	1.718	34.502	13.27	2379168	2463435	5/15/1998	13:21:33.71	4.187	7.641
229	45.594	18.284	1.776	34.496	13.269	2373904	2463396	5/15/1998	13:27:34.50	4.151	7.641
230	45.587	18.272	1.733	34.499	13.27	2389117	2463288	5/15/1998	13:33:35.29	4.255	7.640
231	45.569	18.262	1.717	34.493	13.267	2336928	2464156	5/15/1998	13:39:36.08	3.897	7.644
232	45.566	18.251	1.704	34.5	13.267	2347445	2463202	5/15/1998	13:45:36.87	3.969	7.640
233	45.553	18.236	1.719	34.501	13.267	2364355	2463414	5/15/1998	13:51:37.66	4.085	7.641
234	45.55	18.233	1.674	34.501	13.267	2344025	2463584	5/15/1998	13:57:38.45	3.945	7.641
235	45.533	18.216	1.692	34.502	13.266	2362191	2463667	5/15/1998	14:03:39.24	4.070	7.642
236	45.53	18.213	1.646	34.502	13.267	2383481	2463735	5/15/1998	14:09:40.03	4.216	7.642
237	45.52	18.201	1.668	34.503	13.268	2376804	2463101	5/15/1998	14:15:40.82	4.170	7.639
238	45.509	18.185	1.649	34.507	13.266	2402584	2464023	5/15/1998	14:21:41.61	4.347	7.643
239	45.503	18.184	1.629	34.503	13.266	2353467	2463492	5/15/1998	14:27:42.40	4.010	7.641
240	45.489	18.172	1.598	34.501	13.264	2351016	2463020	5/15/1998	14:33:43.19	3.993	7.639
241	45.482	18.165	1.639	34.501	13.265	2384912	2463441	5/15/1998	14:39:43.98	4.226	7.641
242	45.473	18.152	1.611	34.504	13.263	2363394	2463111	5/15/1998	14:45:44.77	4.078	7.639
243	45.463	18.141	1.592	34.505	13.263	2365024	2463029	5/15/1998	14:51:45.56	4.090	7.639
244	45.453	18.136	1.555	34.501	13.262	2371528	2463597	5/15/1998	14:57:46.35	4.134	7.641
245	45.448	18.13	1.575	34.502	13.262	2352113	2463504	5/15/1998	15:03:47.14	4.001	7.641
246	45.448	18.128	1.579	34.503	13.261	2339784	2463469	5/15/1998	15:09:47.93	3.916	7.641
247	45.442	18.117	1.492	34.507	13.262	2379245	2463490	5/15/1998	15:15:48.72	4.187	7.641
248	45.432	18.104	1.527	34.51	13.261	2383217	2462880	5/15/1998	15:21:49.51	4.214	7.638
249	45.423	18.11	1.499	34.497	13.261	2360587	2463319	5/15/1998	15:27:50.30	4.059	7.640
250	45.42	18.094	1.449	34.508	13.26	2359980	2463330	5/15/1998	15:33:51.09	4.055	7.640
251	45.41	18.091	1.425	34.503	13.259	2363695	2463184	5/15/1998	15:39:51.88	4.080	7.640
252	45.406	18.079	1.45	34.509	13.261	2368615	2463361	5/15/1998	15:45:52.67	4.114	7.640
253	45.399	18.082	1.415	34.501	13.26	2380394	2463643	5/15/1998	15:51:53.46	4.195	7.642
254	45.388	18.077	1.458	34.496	13.259	2324128	2464041	5/15/1998	15:57:54.25	3.809	7.643
255	45.394	18.071	1.451	34.505	13.258	2357274	2464178	5/15/1998	16:03:55.04	4.036	7.644
256	45.391	18.068	1.4	34.505	13.258	2351656	2463736	5/15/1998	16:09:55.83	3.998	7.642
257	45.385	18.058	1.381	34.508	13.258	2381841	2463657	5/15/1998	16:15:56.62	4.205	7.642
258	45.389	18.054	1.4	34.516	13.258	2346587	2464198	5/15/1998	16:21:57.41	3.963	7.644
259	45.386	18.066	1.378	34.503	13.258	2354135	2463708	5/15/1998	16:27:58.20	4.015	7.642
260	45.397	18.068	1.328	34.51	13.258	2381200	2464481	5/15/1998	16:33:58.99	4.201	7.645
261	45.41	18.084	1.345	34.509	13.258	2395788	2463932	5/15/1998	16:39:59.78	4.301	7.643
262	45.414	18.094	1.361	34.503	13.258	2377841	2464211	5/15/1998	16:46:00.57	4.178	7.644
263	45.429	18.104	1.301	34.507	13.259	2358469	2463743	5/15/1998	16:52:01.36	4.045	7.642
264	45.443	18.12	1.315	34.505	13.257	2356930	2465759	5/15/1998	16:58:02.15	4.034	7.651
265	45.458	18.123	1.344	34.517	13.258	2361082	2463896	5/15/1998	17:04:02.94	4.063	7.643
266	45.468	18.141	1.31	34.51	13.258	2390020	2464435	5/15/1998	17:10:03.73	4.261	7.645
267	45.479	18.152	1.308	34.509	13.258	2348005	2464148	5/15/1998	17:16:04.52	3.973	7.644
268	45.492	18.161	1.319	34.513	13.256	2396793	2465141	5/15/1998	17:22:05.31	4.308	7.648
269	45.508	18.183	1.289	34.508	13.258	2381427	2465049	5/15/1998	17:28:06.10	4.202	7.648
270	45.521	18.196	1.339	34.508	13.257	2382892	2464671	5/15/1998	17:34:06.89	4.212	7.646
271	45.533	18.213	1.313	34.504	13.256	2397674	2465097	5/15/1998	17:40:07.68	4.314	7.648
272	45.553	18.23	1.337	34.507	13.258	2402697	2465238	5/15/1998	17:46:08.47	4.348	7.649
273	45.566	18.238	1.322	34.511	13.257	2353153	2465328	5/15/1998	17:52:09.26	4.008	7.649
274	45.582	18.257	1.294	34.509	13.257	2380839	2465578	5/15/1998	17:58:10.05	4.198	7.650
275	45.598	18.272	1.316	34.509	13.256	2394227	2465849	5/15/1998	18:04:10.84	4.290	7.651
276	45.603	18.283	1.355	34.505	13.258	2351650	2465497	5/15/1998	18:10:11.63	3.998	7.650
277	45.62	18.293	1.331	34.51	13.254	2369528	2465711	5/15/1998	18:16:12.42	4.121	7.651
278	45.626	18.304	1.353	34.506	13.258	2397359	2465550	5/15/1998	18:22:13.21	4.312	7.650
279	45.635	18.312	1.321	34.507	13.255	2371123	2466458	5/15/1998	18:28:14.00	4.131	7.654

Record No.	Conductivity (mS/cm)	Temperature (Deg. C)	Pressure (dBar)	Salinity (PSU)	CTD Bat. (Vdc)	D.O. (Integer)	pH (Integer)	Date	Time	D.O. (ml/L)	pH (Value)
280	45.651	18.321	1.353	34.513	13.255	2380264	2466741	5/15/1998	18:34:14.79	4.194	7.655
281	45.657	18.332	1.359	34.509	13.255	2387365	2466233	5/15/1998	18:40:15.58	4.243	7.653
282	45.656	18.336	1.383	34.505	13.253	2391766	2466929	5/15/1998	18:46:57.62	4.273	7.656
283	45.67	18.344	1.353	34.509	13.253	2392285	2466969	5/15/1998	18:52:58.41	4.277	7.656
284	45.669	18.346	1.37	34.507	13.256	2371420	2467163	5/15/1998	18:58:59.20	4.134	7.657
285	45.675	18.351	1.4	34.508	13.254	2364223	2467230	5/15/1998	19:04:59.99	4.084	7.657
286	45.675	18.346	1.415	34.513	13.251	2354463	2466804	5/15/1998	19:11:00.78	4.017	7.655
287	45.677	18.347	1.397	34.513	13.252	2345955	2466627	5/15/1998	19:17:01.57	3.959	7.655
288	45.684	18.358	1.384	34.51	13.254	2385862	2467170	5/15/1998	19:23:02.36	4.233	7.657
289	45.686	18.368	1.418	34.503	13.252	2359116	2466945	5/15/1998	19:29:03.15	4.049	7.656
290	45.698	18.365	1.445	34.516	13.251	2381054	2467458	5/15/1998	19:35:03.94	4.200	7.658
291	45.697	18.369	1.513	34.511	13.25	2375820	2467191	5/15/1998	19:41:04.73	4.164	7.657
292	45.698	18.374	1.507	34.508	13.25	2377280	2467003	5/15/1998	19:47:05.52	4.174	7.656
293	45.706	18.378	1.524	34.512	13.25	2391057	2467266	5/15/1998	19:53:06.31	4.268	7.657
294	45.703	18.376	1.579	34.511	13.249	2362852	2466873	5/15/1998	19:59:07.10	4.075	7.656
295	45.705	18.378	1.563	34.511	13.249	2381681	2467730	5/15/1998	20:05:07.89	4.204	7.659
296	45.708	18.376	1.559	34.515	13.249	2385570	2467100	5/15/1998	20:11:08.68	4.231	7.657
297	45.7	18.375	1.599	34.509	13.248	2337237	2467344	5/15/1998	20:17:09.47	3.899	7.658
298	45.703	18.376	1.558	34.51	13.249	2382983	2467469	5/15/1998	20:23:10.26	4.213	7.658
299	45.702	18.365	1.58	34.519	13.249	2374780	2467039	5/15/1998	20:29:11.05	4.157	7.656
300	45.697	18.371	1.627	34.51	13.248	2370041	2466759	5/15/1998	20:35:11.84	4.124	7.655
301	45.696	18.366	1.691	34.513	13.247	2323110	2467521	5/15/1998	20:41:12.63	3.802	7.658
302	45.688	18.359	1.734	34.512	13.246	2349356	2468039	5/15/1998	20:47:13.42	3.982	7.661
303	45.687	18.351	1.722	34.518	13.247	2382767	2467841	5/15/1998	20:53:14.21	4.211	7.660
304	45.676	18.349	1.759	34.511	13.244	2384210	2468098	5/15/1998	20:59:15.00	4.221	7.661
305	45.661	18.335	1.741	34.509	13.245	2388360	2466741	5/15/1998	21:05:15.79	4.250	7.655
306	45.637	18.31	1.756	34.51	13.243	2369829	2467429	5/15/1998	21:11:16.58	4.123	7.658
307	45.624	18.294	1.759	34.513	13.245	2372489	2467231	5/15/1998	21:17:17.37	4.141	7.657
308	45.616	18.28	1.732	34.518	13.244	2376284	2467547	5/15/1998	21:23:18.16	4.167	7.658
309	45.597	18.259	1.783	34.52	13.241	2370010	2467382	5/15/1998	21:29:18.95	4.124	7.658
310	45.572	18.235	1.846	34.519	13.242	2369035	2467334	5/15/1998	21:35:19.74	4.117	7.658
311	45.56	18.217	1.82	34.523	13.243	2359090	2466974	5/15/1998	21:41:20.53	4.049	7.656
312	45.54	18.213	1.892	34.51	13.24	2373006	2467145	5/15/1998	21:47:21.32	4.144	7.657
313	45.524	18.19	1.88	34.516	13.24	2384965	2468153	5/15/1998	21:53:22.11	4.226	7.661
314	45.51	18.184	1.891	34.508	13.24	2372198	2467057	5/15/1998	21:59:22.90	4.139	7.656
315	45.501	18.163	1.922	34.519	13.24	2367592	2467374	5/15/1998	22:05:23.69	4.107	7.658
316	45.49	18.151	1.893	34.519	13.24	2371961	2467695	5/15/1998	22:11:24.48	4.137	7.659
317	45.482	18.138	1.963	34.524	13.238	2337747	2467876	5/15/1998	22:17:25.27	3.902	7.660
318	45.469	18.124	1.91	34.525	13.239	2319494	2467315	5/15/1998	22:23:26.06	3.777	7.657
319	45.461	18.121	1.931	34.52	13.239	2375343	2467483	5/15/1998	22:29:26.85	4.160	7.658
320	45.448	18.107	1.918	34.52	13.237	2377429	2467054	5/15/1998	22:35:27.64	4.175	7.656
321	45.435	18.1	1.969	34.516	13.238	2376011	2467161	5/15/1998	22:41:28.43	4.165	7.657
322	45.429	18.088	1.956	34.52	13.237	2356935	2467112	5/15/1998	22:47:29.22	4.034	7.657
323	45.423	18.08	2.023	34.523	13.237	2367734	2467518	5/15/1998	22:53:30.01	4.108	7.658
324	45.418	18.073	1.985	34.524	13.237	2379972	2467754	5/15/1998	22:59:30.80	4.192	7.659
325	45.414	18.073	1.998	34.52	13.237	2345571	2467752	5/15/1998	23:05:31.59	3.956	7.659
326	45.407	18.061	1.987	34.525	13.235	2339841	2467434	5/15/1998	23:11:32.38	3.917	7.658
327	45.408	18.071	1.978	34.517	13.236	2359499	2467795	5/15/1998	23:17:33.17	4.052	7.660
328	45.401	18.057	1.996	34.524	13.233	2358925	2467783	5/15/1998	23:23:33.96	4.048	7.660
329	45.405	18.058	1.971	34.526	13.234	2395086	2468229	5/15/1998	23:29:34.75	4.296	7.661
330	45.401	18.05	2.04	34.529	13.235	2365691	2467615	5/15/1998	23:35:35.54	4.094	7.659
331	45.405	18.062	2.014	34.522	13.234	2355304	2467233	5/15/1998	23:41:36.33	4.023	7.657
332	45.407	18.053	1.99	34.532	13.233	2383424	2467011	5/15/1998	23:47:37.12	4.216	7.656
333	45.4	18.056	2.009	34.523	13.232	2383121	2467779	5/15/1998	23:53:37.91	4.214	7.659
334	45.395	18.052	2.015	34.523	13.233	2377891	2467329	5/15/1998	23:59:38.70	4.178	7.658
335	45.405	18.05	1.989	34.533	13.232	2395826	2467853	5/16/1998	00:05:39.49	4.301	7.660
336	45.406	18.057	1.969	34.527	13.231	2373496	2467524	5/16/1998	00:11:40.28	4.148	7.658
337	45.395	18.042	1.985	34.53	13.231	2346109	2467578	5/16/1998	00:17:41.07	3.960	7.659
338	45.394	18.049	1.988	34.524	13.23	2356741	2468195	5/16/1998	00:23:41.86	4.033	7.661
339	45.389	18.031	1.952	34.535	13.231	2372855	2467422	5/16/1998	00:29:42.65	4.143	7.658
340	45.39	18.033	1.957	34.533	13.228	2356792	2467648	5/16/1998	00:35:43.44	4.033	7.659
341	45.386	18.033	1.932	34.531	13.233	2359037	2467677	5/16/1998	00:41:44.23	4.049	7.659
342	45.378	18.029	1.926	34.527	13.229	2357632	2467844	5/16/1998	00:47:45.02	4.039	7.660
343	45.375	18.027	1.923	34.526	13.228	2363040	2467285	5/16/1998	00:53:45.81	4.076	7.657
344	45.371	18.024	1.915	34.526	13.227	2359224	2467800	5/16/1998	00:59:46.60	4.050	7.660
345	45.37	18.022	1.862	34.526	13.231	2355096	2467827	5/16/1998	01:05:47.39	4.021	7.660
346	45.36	18.015	1.816	34.523	13.229	2352383	2467772	5/16/1998	01:11:48.18	4.003	7.659
347	45.351	18.003	1.846	34.527	13.229	2340953	2467358	5/16/1998	01:17:48.97	3.924	7.658
348	45.345	18.002	1.81	34.522	13.229	2367112	2467796	5/16/1998	01:23:49.76	4.104	7.660
349	45.345	17.992	1.778	34.531	13.23	2358870	2467168	5/16/1998	01:29:50.55	4.047	7.657
350	45.337	17.989	1.78	34.526	13.229	2377140	2467209	5/16/1998	01:35:51.34	4.173	7.657
351	45.331	17.982	1.712	34.527	13.229	2375405	2467268	5/16/1998	01:41:52.13	4.161	7.657
352	45.332	17.976	1.71	34.533	13.227	2348207	2467943	5/16/1998	01:48:34.16	3.974	7.660
353	45.329	17.976	1.685	34.53	13.226	2374527	2467638	5/16/1998	01:54:34.95	4.155	7.659
354	45.33	17.98	1.633	34.528	13.227	2349078	2467880	5/16/1998	02:00:35.74	3.980	7.660
355	45.328	17.973	1.631	34.532	13.225	2366638	2467221	5/16/1998	02:06:36.53	4.101	7.657
356	45.327	17.978	1.579	34.527	13.225	2350933	2467135	5/16/1998	02:12:37.32	3.993	7.657
357	45.327	17.981	1.583	34.525	13.226	2350551	2468078	5/16/1998	02:18:38.11	3.990	7.661
358	45.328	17.975	1.532	34.53	13.224	2360349	2467595	5/16/1998	02:24:38.90	4.058	7.659
359	45.32	17.971	1.498	34.527	13.225	2377524	2467360	5/16/1998	02:30:39.69	4.175	7.658
360	45.327	17.971	1.476	34.532	13.224	2362956	2467649	5/16/1998	02:36:40.48	4.075	7.659
361	45.32	17.973	1.422	34.525	13.223	2389833	2467475	5/16/1998	02:42:41.27	4.260	7.658
362	45.323	17.976	1.398	34.526	13.224	2361460	2467332	5/16/1998	02:48:42.06	4.065	7.658
363	45.317	17.969	1.356	34.526	13.222	2354738	2467231	5/16/1998	02:54:42.85	4.019	7.657
364	45.325	17.969	1.28	34.533	13.222	2354665	2467091	5/16/1998	03:00:43.64	4.019	7.657
365	45.327	17.969	1.289	34.535	13.222	2408383	2467583	5/16/1998	03:06:44.43	4.387	7.659
366	45.327	17.974	1.278	34.53	13.221	2367075	2467466	5/16/1998	03:12:45.22	4.104	7.658
367	45.324	17.967	1.248	34.534	13.222	2330680	2467166	5/16/1998	03:18:46.01	3.854	7.657
368	45.325	17.974	1.178	34.529	13.22	2369441	2467372	5/16/1998	03:24:46.80	4.120	7.658
369	45.332	17.973	1.115	34.536	13.22	2334352	2467339	5/16/1998	03:30:47.59	3.879	7.658
370	45.335	17.987	1.101	34.526	13.222	2343750	2467793	5/16/1998	03:36:48.38	3.944	7.660
371	45.338	17.981	1.073	34.534	13.219	2338593	2467577	5/16/1998	03:42:49.17	3.908	7.659
372	45.339	17.98	1.038	34.535	13.22	2297495	2467468	5/16/1998	03:48:49.96	3.626	7.658
373	45.34	17.983	1.022	34.534	13.219	2362710	2467716	5/16/1998	03:54:50.75	4.074	7.659

Record No.	Conductivity (mS/cm)	Temperature (Deg. C)	Pressure (dBar)	Salinity (PSU)	CTD Bat. (Vdc)	D.O. (Integer)	pH (Integer)	Date	Time	D.O. (ml/L)	pH (Value)
374	45.345	17.988	0.97	34.534	13.218	2356859	2467618	5/16/1998	04:00:51.54	4.034	7.659
375	45.345	17.986	0.936	34.536	13.22	2344295	2467594	5/16/1998	04:06:52.33	3.947	7.659
376	45.342	17.987	0.902	34.533	13.219	2359049	2467549	5/16/1998	04:12:53.12	4.049	7.658
377	45.341	17.993	0.858	34.526	13.22	2362960	2467567	5/16/1998	04:18:53.91	4.075	7.659
378	45.344	17.987	0.827	34.535	13.22	2354292	2467652	5/16/1998	04:24:54.70	4.016	7.659
379	45.353	17.994	0.798	34.536	13.217	2346094	2467114	5/16/1998	04:30:55.49	3.960	7.657
380	45.356	18.003	0.769	34.531	13.22	2370973	2468124	5/16/1998	04:36:56.28	4.130	7.661
381	45.367	18.01	0.74	34.534	13.221	2357293	2467836	5/16/1998	04:42:57.07	4.037	7.660
382	45.38	18.032	0.708	34.526	13.221	2345507	2467879	5/16/1998	04:48:57.86	3.956	7.660
383	45.399	18.041	0.655	34.535	13.223	2333597	2468524	5/16/1998	04:54:58.65	3.874	7.663
384	45.421	18.071	0.663	34.528	13.223	2370228	2467806	5/16/1998	05:00:59.44	4.125	7.660
385	45.44	18.086	0.61	34.532	13.222	2391255	2467502	5/16/1998	05:07:00.23	4.270	7.658
386	45.461	18.107	0.572	34.532	13.221	2366862	2467934	5/16/1998	05:13:01.02	4.102	7.660
387	45.48	18.126	0.555	34.532	13.222	2367017	2467180	5/16/1998	05:19:01.81	4.103	7.657
388	45.493	18.149	0.556	34.524	13.22	2330259	2468073	5/16/1998	05:25:02.60	3.851	7.661
389	45.509	18.161	0.526	34.527	13.221	2377135	2467749	5/16/1998	05:31:03.39	4.173	7.659
390	45.527	18.177	0.489	34.529	13.219	2341738	2467318	5/16/1998	05:37:04.18	3.930	7.658
391	45.545	18.192	0.473	34.532	13.22	2375006	2467446	5/16/1998	05:43:04.97	4.158	7.658
392	45.566	18.213	0.444	34.533	13.222	2372313	2467936	5/16/1998	05:49:05.76	4.140	7.660
393	45.585	18.231	0.447	34.534	13.222	2328565	2467610	5/16/1998	05:55:06.55	3.839	7.659
394	45.592	18.243	0.433	34.529	13.227	2375820	2467135	5/16/1998	06:01:07.34	4.164	7.657
395	45.611	18.262	0.416	34.53	13.223	2358893	2467654	5/16/1998	06:07:08.13	4.048	7.659
396	45.623	18.277	0.377	34.527	13.225	2346040	2466958	5/16/1998	06:13:08.92	3.959	7.656
397	45.639	18.284	0.368	34.534	13.225	2372790	2466916	5/16/1998	06:19:09.71	4.143	7.656
398	45.652	18.305	0.371	34.527	13.223	2364436	2467155	5/16/1998	06:25:10.50	4.086	7.657
399	45.67	18.313	0.364	34.537	13.224	2377688	2466795	5/16/1998	06:31:11.29	4.177	7.655
400	45.679	18.333	0.365	34.527	13.222	2357551	2467141	5/16/1998	06:37:12.08	4.038	7.657
401	45.689	18.345	0.343	34.526	13.222	2339971	2466786	5/16/1998	06:43:12.87	3.918	7.655
402	45.704	18.364	0.319	34.522	13.223	2356143	2467253	5/16/1998	06:49:13.66	4.029	7.657
403	45.716	18.36	0.289	34.536	13.224	2358772	2466608	5/16/1998	06:55:14.45	4.047	7.654
404	45.728	18.376	0.292	34.532	13.223	2348538	2466863	5/16/1998	07:01:15.24	3.976	7.656
405	45.739	18.393	0.299	34.527	13.226	2360453	2466802	5/16/1998	07:07:16.03	4.058	7.655
406	45.747	18.4	0.29	34.528	13.221	2365582	2467431	5/16/1998	07:13:16.82	4.093	7.658
407	45.759	18.416	0.289	34.525	13.221	2349223	2466994	5/16/1998	07:19:17.61	3.981	7.656
408	45.767	18.42	0.308	34.528	13.222	2352634	2466620	5/16/1998	07:25:18.40	4.005	7.654
409	45.781	18.438	0.298	34.525	13.222	2383224	2466270	5/16/1998	07:31:19.19	4.215	7.653
410	45.796	18.451	0.342	34.527	13.22	2348780	2466878	5/16/1998	07:37:19.98	3.978	7.656
411	45.807	18.454	0.34	34.534	13.221	2345413	2466815	5/16/1998	07:43:20.77	3.955	7.655
412	45.812	18.472	0.322	34.522	13.222	2363050	2466966	5/16/1998	07:49:21.56	4.076	7.656
413	45.829	18.484	0.296	34.527	13.222	2391920	2466354	5/16/1998	07:55:22.35	4.274	7.653
414	45.838	18.491	0.306	34.528	13.221	2343056	2466144	5/16/1998	08:01:23.14	3.939	7.652
415	45.851	18.5	0.303	34.532	13.222	2362069	2466077	5/16/1998	08:07:23.93	4.069	7.652
416	45.863	18.52	0.354	34.525	13.221	2358005	2465813	5/16/1998	08:13:24.72	4.041	7.651
417	45.876	18.532	0.366	34.526	13.22	2346991	2466243	5/16/1998	08:19:25.51	3.966	7.653
418	45.888	18.54	0.367	34.529	13.22	2374849	2465587	5/16/1998	08:25:26.30	4.157	7.650
419	45.894	18.545	0.368	34.531	13.219	2367514	2465572	5/16/1998	08:31:27.09	4.107	7.650
420	45.905	18.556	0.433	34.53	13.22	2355595	2465302	5/16/1998	08:37:27.88	4.025	7.649
421	45.914	18.572	0.427	34.525	13.221	2362177	2465679	5/16/1998	08:43:28.67	4.070	7.650
422	45.916	18.572	0.407	34.527	13.219	2376817	2465779	5/16/1998	08:50:10.73	4.171	7.651
423	45.928	18.577	0.46	34.533	13.22	2370694	2465513	5/16/1998	08:56:11.52	4.129	7.650
424	45.93	18.588	0.433	34.524	13.218	2364710	2465486	5/16/1998	09:02:12.31	4.087	7.650
425	45.934	18.587	0.466	34.529	13.219	2370880	2465688	5/16/1998	09:08:13.10	4.130	7.650
426	45.946	18.603	0.49	34.526	13.22	2362163	2465688	5/16/1998	09:14:13.89	4.070	7.650
427	45.951	18.607	0.519	34.526	13.217	2377732	2465540	5/16/1998	09:20:14.68	4.177	7.650
428	45.954	18.613	0.542	34.524	13.218	2343442	2465321	5/16/1998	09:26:15.47	3.941	7.649
429	45.958	18.619	0.555	34.522	13.218	2364455	2465740	5/16/1998	09:32:16.26	4.086	7.651
430	45.957	18.615	0.571	34.525	13.217	2345549	2465131	5/16/1998	09:38:17.05	3.956	7.648
431	45.958	18.616	0.619	34.525	13.217	2364135	2465252	5/16/1998	09:44:17.84	4.084	7.649
432	45.965	18.624	0.645	34.524	13.217	2378187	2464878	5/16/1998	09:50:18.63	4.180	7.647
433	45.962	18.615	0.629	34.53	13.216	2367755	2465241	5/16/1998	09:56:19.42	4.108	7.649
434	45.968	18.626	0.661	34.525	13.217	2371058	2465142	5/16/1998	10:02:20.21	4.131	7.648
435	45.971	18.629	0.655	34.525	13.218	2374850	2464974	5/16/1998	10:08:21.00	4.157	7.647
436	45.974	18.636	0.683	34.522	13.215	2370542	2464716	5/16/1998	10:14:21.79	4.127	7.646
437	45.971	18.639	0.709	34.517	13.218	2337076	2464915	5/16/1998	10:20:22.58	3.898	7.647
438	45.977	18.64	0.746	34.521	13.219	2407642	2464544	5/16/1998	10:26:23.37	4.382	7.646
439	45.981	18.64	0.815	34.524	13.215	2364894	2464814	5/16/1998	10:32:24.16	4.089	7.647
440	45.988	18.641	0.789	34.529	13.214	2365434	2464745	5/16/1998	10:38:24.95	4.092	7.646
441	45.98	18.638	0.808	34.525	13.214	2363864	2464677	5/16/1998	10:44:25.74	4.082	7.646
442	45.981	18.646	0.812	34.52	13.215	2355393	2465537	5/16/1998	10:50:26.53	4.024	7.650
443	45.983	18.645	0.865	34.522	13.214	2369408	2464854	5/16/1998	10:56:27.32	4.120	7.647
444	45.975	18.636	0.852	34.522	13.214	2375164	2465230	5/16/1998	11:02:28.11	4.159	7.648
445	45.972	18.63	0.854	34.525	13.213	2419238	2464471	5/16/1998	11:08:28.90	4.462	7.645
446	45.961	18.621	0.885	34.523	13.212	2341615	2464577	5/16/1998	11:14:29.69	3.929	7.646
447	45.954	18.61	0.929	34.527	13.212	2371574	2464745	5/16/1998	11:20:30.48	4.135	7.646
448	45.939	18.6	0.976	34.522	13.212	2386174	2464794	5/16/1998	11:26:31.27	4.235	7.647
449	45.935	18.589	0.992	34.528	13.211	2372143	2464763	5/16/1998	11:32:32.06	4.138	7.646
450	45.924	18.581	1.002	34.525	13.211	2356895	2464913	5/16/1998	11:38:32.85	4.034	7.647
451	45.911	18.572	1.013	34.522	13.21	2405453	2464511	5/16/1998	11:44:33.64	4.367	7.645
452	45.902	18.56	1.028	34.525	13.211	2394661	2464205	5/16/1998	11:50:34.43	4.293	7.644
453	45.889	18.542	1.084	34.529	13.21	2388545	2464097	5/16/1998	11:56:35.22	4.251	7.644
454	45.874	18.531	1.063	34.525	13.21	2369847	2464778	5/16/1998	12:02:36.01	4.123	7.647
455	45.867	18.515	1.023	34.533	13.21	2346747	2463775	5/16/1998	12:08:36.80	3.964	7.642
456	45.853	18.515	1.107	34.521	13.209	2377117	2464732	5/16/1998	12:14:37.59	4.173	7.646
457	45.839	18.499	1.12	34.522	13.209	2345139	2463841	5/16/1998	12:20:38.38	3.953	7.642
458	45.825	18.474	1.143	34.532	13.208	2376179	2464477	5/16/1998	12:26:39.17	4.166	7.645
459	45.81	18.47	1.125	34.522	13.208	2373567	2464374	5/16/1998	12:32:39.96	4.148	7.645
460	45.816	18.465	1.129	34.532	13.206	2380481	2464950	5/16/1998	12:38:40.75	4.196	7.647
461	45.807	18.462	1.137	34.527	13.209	2327573	2464215	5/16/1998	12:44:41.54	3.833	7.644
462	45.797	18.451	1.158	34.527	13.207	2389970	2464029	5/16/1998	12:50:42.33	4.261	7.643
463	45.788	18.435	1.178	34.533	13.206	2379758	2464539	5/16/1998	12:56:43.12	4.191	7.645
464	45.787	18.438	1.186	34.529	13.207	2358934	2463697	5/16/1998	13:02:43.91	4.048	7.642
465	45.781	18.431	1.207	34.531	13.206	2353875	2464250	5/16/1998	13:08:44.70	4.013	7.644
466	45.767	18.424	1.188	34.525	13.206	2370977	2465039	5/16/1998	13:14:45.49	4.130	7.648
467	45.757	18.407	1.183	34.531	13.203	2362247	2465663	5/16/1998	13:20:46.28	4.071	7.650

Record No.	Conductivity (mS/cm)	Temperature (Deg. C)	Pressure (dBar)	Salinity (PSU)	CTD Bat. (Vdc)	D.O. (Integer)	pH (Integer)	Date	Time	D.O. (ml/L)	pH (Value)
468	45.75	18.398	1.229	34.532	13.204	2382850	2463941	5/16/1998	13:26:47.07	4.212	7.643
469	45.739	18.386	1.211	34.533	13.203	2354702	2465103	5/16/1998	13:32:47.86	4.019	7.648
470	45.734	18.389	1.215	34.526	13.203	2358478	2464088	5/16/1998	13:38:48.65	4.045	7.644
471	45.727	18.38	1.242	34.528	13.202	2373397	2464084	5/16/1998	13:44:49.44	4.147	7.644
472	45.719	18.367	1.233	34.532	13.199	2363116	2465939	5/16/1998	13:50:50.23	4.077	7.652
473	45.706	18.367	1.227	34.521	13.2	2378673	2464619	5/16/1998	13:56:51.02	4.183	7.646
474	45.703	18.343	1.21	34.538	13.199	2372531	2463910	5/16/1998	14:02:51.81	4.141	7.643
475	45.685	18.333	1.214	34.532	13.199	2370729	2464530	5/16/1998	14:08:52.60	4.129	7.645
476	45.681	18.316	1.202	34.543	13.198	2346686	2464976	5/16/1998	14:14:53.39	3.964	7.647
477	45.662	18.308	1.228	34.533	13.2	2341954	2464430	5/16/1998	14:20:54.18	3.931	7.645
478	45.657	18.311	1.209	34.527	13.201	2357701	2464421	5/16/1998	14:26:54.97	4.039	7.645
479	45.653	18.302	1.209	34.531	13.199	2335402	2464029	5/16/1998	14:32:55.76	3.886	7.643
480	45.639	18.283	1.193	34.535	13.198	2363415	2465040	5/16/1998	14:38:56.55	4.079	7.648
481	45.632	18.282	1.196	34.53	13.199	2367654	2464068	5/16/1998	14:44:57.34	4.108	7.643
482	45.625	18.273	1.198	34.531	13.199	2361687	2463712	5/16/1998	14:50:58.13	4.067	7.642
483	45.616	18.262	1.192	34.534	13.199	2332234	2464235	5/16/1998	14:56:58.92	3.865	7.644
484	45.606	18.253	1.151	34.532	13.197	2387899	2464733	5/16/1998	15:02:59.71	4.247	7.646
485	45.599	18.241	1.165	34.536	13.198	2358923	2463690	5/16/1998	15:09:00.50	4.048	7.642
486	45.595	18.238	1.168	34.536	13.2	2388218	2464004	5/16/1998	15:15:01.29	4.249	7.643
487	45.583	18.223	1.159	34.538	13.197	2380298	2464683	5/16/1998	15:21:02.08	4.194	7.646
488	45.571	18.22	1.115	34.531	13.197	2386229	2464287	5/16/1998	15:27:02.87	4.235	7.644
489	45.566	18.203	1.143	34.541	13.197	2326244	2464329	5/16/1998	15:33:03.66	3.823	7.645
490	45.556	18.196	1.157	34.538	13.198	2391305	2464642	5/16/1998	15:39:04.45	4.270	7.646
491	45.552	18.193	1.087	34.537	13.196	2367932	2464694	5/16/1998	15:45:05.24	4.110	7.646
492	45.533	18.176	1.061	34.535	13.194	2364999	2464541	5/16/1998	15:51:47.30	4.089	7.646
493	45.526	18.17	1.072	34.534	13.195	2375858	2464794	5/16/1998	15:57:48.09	4.164	7.647
494	45.516	18.152	1.027	34.541	13.194	2348960	2464449	5/16/1998	16:03:48.88	3.979	7.645
495	45.504	18.147	1.062	34.535	13.194	2352109	2464971	5/16/1998	16:09:49.67	4.001	7.647
496	45.498	18.136	1.032	34.539	13.195	2352347	2464998	5/16/1998	16:15:50.46	4.003	7.647
497	45.493	18.136	1.005	34.535	13.194	2339196	2464992	5/16/1998	16:21:51.25	3.912	7.647
498	45.487	18.126	1.015	34.538	13.196	2361574	2464142	5/16/1998	16:27:52.04	4.066	7.644
499	45.482	18.12	1.022	34.539	13.193	2360144	2464436	5/16/1998	16:33:52.83	4.056	7.645
500	45.474	18.108	0.967	34.543	13.194	2337115	2464595	5/16/1998	16:39:53.62	3.898	7.646
501	45.463	18.091	0.964	34.547	13.193	2351100	2464490	5/16/1998	16:45:54.41	3.994	7.645
502	45.451	18.088	0.933	34.54	13.193	2383584	2464778	5/16/1998	16:51:55.20	4.217	7.647
503	45.446	18.074	0.921	34.547	13.192	2361530	2465183	5/16/1998	16:57:55.99	4.066	7.648
504	45.441	18.07	0.908	34.546	13.193	2391573	2464763	5/16/1998	17:03:56.78	4.272	7.646
505	45.448	18.085	0.943	34.54	13.193	2375491	2464601	5/16/1998	17:09:57.57	4.161	7.646
506	45.45	18.089	0.905	34.538	13.194	2389529	2464738	5/16/1998	17:15:58.36	4.258	7.646
507	45.46	18.097	0.91	34.54	13.192	2340969	2464962	5/16/1998	17:21:59.15	3.925	7.647
508	45.477	18.117	0.909	34.537	13.192	2342003	2464992	5/16/1998	17:27:59.94	3.932	7.647
509	45.488	18.132	0.888	34.534	13.192	2372901	2465404	5/16/1998	17:34:00.73	4.144	7.649
510	45.502	18.134	0.892	34.544	13.191	2374499	2465829	5/16/1998	17:40:01.52	4.155	7.651
511	45.518	18.157	0.904	34.539	13.188	2332155	2466200	5/16/1998	17:46:02.31	3.864	7.653
512	45.53	18.167	0.847	34.541	13.19	2345892	2465381	5/16/1998	17:52:03.10	3.958	7.649
513	45.553	18.186	0.888	34.543	13.19	2378091	2465739	5/16/1998	17:58:03.89	4.179	7.651
514	45.57	18.205	0.86	34.542	13.188	2367452	2465820	5/16/1998	18:04:04.68	4.106	7.651
515	45.591	18.23	0.865	34.539	13.188	2339761	2465898	5/16/1998	18:10:05.47	3.916	7.651
516	45.611	18.242	0.853	34.546	13.191	2346266	2466400	5/16/1998	18:16:06.26	3.961	7.654
517	45.623	18.261	0.871	34.54	13.188	2364061	2466960	5/16/1998	18:22:07.05	4.083	7.656
518	45.637	18.28	0.857	34.535	13.186	2372822	2466124	5/16/1998	18:28:07.84	4.143	7.652
519	45.656	18.293	0.844	34.542	13.187	2365685	2466685	5/16/1998	18:34:08.63	4.094	7.655
520	45.67	18.305	0.878	34.543	13.187	2353791	2466438	5/16/1998	18:40:09.42	4.013	7.654
521	45.668	18.312	0.839	34.536	13.184	2386575	2466954	5/16/1998	18:46:10.21	4.238	7.656
522	45.683	18.322	0.833	34.54	13.186	2354987	2466560	5/16/1998	18:52:11.00	4.021	7.654
523	45.692	18.325	0.869	34.544	13.187	2354107	2466625	5/16/1998	18:58:11.79	4.015	7.655
524	45.696	18.336	0.908	34.538	13.189	2341134	2466451	5/16/1998	19:04:12.58	3.926	7.654
525	45.694	18.335	0.875	34.538	13.187	2368882	2466764	5/16/1998	19:10:13.37	4.116	7.655
526	45.697	18.333	0.924	34.542	13.186	2347339	2466919	5/16/1998	19:16:14.16	3.968	7.656
527	45.693	18.337	0.87	34.535	13.186	2378758	2467027	5/16/1998	19:22:14.95	4.184	7.656
528	45.697	18.335	0.918	34.54	13.184	2362681	2467232	5/16/1998	19:28:15.74	4.074	7.657
529	45.694	18.331	0.886	34.542	13.187	2366986	2466913	5/16/1998	19:34:16.53	4.103	7.656
530	45.691	18.324	0.89	34.545	13.185	2360421	2468338	5/16/1998	19:40:17.32	4.058	7.662
531	45.687	18.325	0.894	34.541	13.183	2379600	2468490	5/16/1998	19:46:18.11	4.190	7.663
532	45.693	18.32	0.901	34.549	13.183	2359686	2468207	5/16/1998	19:52:18.90	4.053	7.661
533	45.689	18.33	0.941	34.537	13.185	2397885	2467017	5/16/1998	19:58:19.69	4.315	7.656
534	45.685	18.319	0.949	34.544	13.187	2350642	2466877	5/16/1998	20:04:20.48	3.991	7.656
535	45.679	18.317	0.969	34.54	13.184	2378571	2466798	5/16/1998	20:10:21.27	4.183	7.655
536	45.684	18.317	0.933	34.545	13.183	2346928	2468411	5/16/1998	20:16:22.06	3.965	7.662
537	45.682	18.314	0.962	34.545	13.185	2334539	2467785	5/16/1998	20:22:22.85	3.880	7.660
538	45.682	18.318	0.998	34.542	13.184	2339871	2467012	5/16/1998	20:28:23.64	3.917	7.656
539	45.68	18.317	0.961	34.542	13.185	2362783	2466783	5/16/1998	20:34:24.43	4.074	7.655
540	45.683	18.318	0.974	34.543	13.184	2383029	2467048	5/16/1998	20:40:25.22	4.213	7.656
541	45.681	18.318	1.006	34.541	13.182	2363565	2468321	5/16/1998	20:46:26.01	4.080	7.662
542	45.684	18.316	1.053	34.546	13.185	2369824	2467478	5/16/1998	20:52:26.80	4.123	7.658
543	45.67	18.308	1.047	34.541	13.182	2368282	2469173	5/16/1998	20:58:27.59	4.112	7.666
544	45.666	18.299	1.073	34.545	13.183	2326759	2467904	5/16/1998	21:04:28.38	3.827	7.660
545	45.66	18.295	1.068	34.543	13.182	2342929	2467685	5/16/1998	21:10:29.17	3.938	7.659
546	45.658	18.304	1.076	34.534	13.179	2361774	2467671	5/16/1998	21:16:29.96	4.067	7.659
547	45.653	18.286	1.12	34.544	13.181	2353908	2467763	5/16/1998	21:22:30.75	4.013	7.659
548	45.648	18.276	1.125	34.548	13.179	2337217	2467807	5/16/1998	21:28:31.54	3.899	7.660
549	45.639	18.264	1.127	34.551	13.179	2371271	2467590	5/16/1998	21:34:32.33	4.132	7.659
550	45.632	18.262	1.117	34.547	13.178	2367347	2467603	5/16/1998	21:40:33.12	4.106	7.659
551	45.617	18.25	1.157	34.544	13.178	2352441	2467076	5/16/1998	21:46:33.91	4.003	7.656
552	45.606	18.237	1.171	34.546	13.178	2354748	2467900	5/16/1998	21:52:34.70	4.019	7.660
553	45.592	18.224	1.195	34.545	13.178	2368829	2467686	5/16/1998	21:58:35.49	4.116	7.659
554	45.584	18.214	1.189	34.547	13.176	2384793	2467288	5/16/1998	22:04:36.28	4.225	7.657
555	45.563	18.198	1.21	34.543	13.176	2348787	2467643	5/16/1998	22:10:37.07	3.978	7.659
556	45.556	18.184	1.212	34.548	13.178	2345808	2467217	5/16/1998	22:16:37.86	3.958	7.657
557	45.532	18.165	1.227	34.544	13.176	2363619	2467489	5/16/1998	22:22:38.65	4.080	7.658
558	45.513	18.143	1.246	34.546	13.176	2359755	2467180	5/16/1998	22:28:39.44	4.053	7.657
559	45.491	18.108	1.232	34.557	13.175	2343311	2468087	5/16/1998	22:34:40.23	3.941	7.661
560	45.483	18.103	1.226	34.554	13.174	2342689	2467742	5/16/1998	22:40:41.02	3.936	7.659
561	45.467	18.098	1.279	34.546	13.171	2364423	2467491	5/16/1998	22:46:41.81	4.085	7.658

Record No.	Conductivity (mS/cm)	Temperature (Deg. C)	Pressure (dBar)	Salinity (PSU)	CTD Bat. (Vdc)	D.O. (Integer)	pH (Integer)	Date	Time	D.O. (ml/L)	pH (Value)
562	45.444	18.073	1.286	34.547	13.173	2365753	2467437	5/16/1998	22:53:23.87	4.095	7.658
563	45.422	18.039	1.301	34.557	13.171	2370680	2468064	5/16/1998	22:59:24.66	4.128	7.661
564	45.41	18.037	1.281	34.548	13.171	2372768	2467330	5/16/1998	23:05:25.45	4.143	7.658
565	45.397	18.017	1.311	34.553	13.171	2338758	2467691	5/16/1998	23:11:26.24	3.909	7.659
566	45.388	18.008	1.332	34.554	13.173	2347926	2467937	5/16/1998	23:17:27.03	3.972	7.660
567	45.38	17.998	1.349	34.555	13.172	2348759	2467185	5/16/1998	23:23:27.82	3.978	7.657
568	45.364	17.977	1.334	34.56	13.169	2365185	2467211	5/16/1998	23:29:28.61	4.091	7.657
569	45.358	17.972	1.278	34.558	13.171	2351984	2467960	5/16/1998	23:35:29.40	4.000	7.660
570	45.352	17.962	1.343	34.562	13.172	2337874	2467387	5/16/1998	23:41:30.19	3.903	7.658
571	45.34	17.954	1.382	34.559	13.17	2321696	2467304	5/16/1998	23:47:30.98	3.792	7.657
572	45.322	17.941	1.399	34.554	13.169	2358306	2467359	5/16/1998	23:53:31.77	4.044	7.658
573	45.319	17.939	1.339	34.554	13.17	2337583	2467462	5/16/1998	23:59:32.56	3.901	7.658
574	45.318	17.929	1.312	34.561	13.169	2365470	2467248	5/17/1998	00:05:33.35	4.093	7.657
575	45.312	17.925	1.315	34.559	13.167	2349387	2467050	5/17/1998	00:11:34.14	3.982	7.656
576	45.311	17.916	1.402	34.565	13.168	2353205	2467416	5/17/1998	00:17:34.93	4.008	7.658
577	45.301	17.92	1.411	34.554	13.166	2337473	2467619	5/17/1998	00:23:35.72	3.901	7.659
578	45.3	17.914	1.351	34.559	13.169	2358633	2467290	5/17/1998	00:29:36.51	4.046	7.657
579	45.306	17.919	1.343	34.559	13.167	2341838	2467741	5/17/1998	00:35:37.30	3.930	7.659
580	45.303	17.921	1.378	34.555	13.168	2335597	2467766	5/17/1998	00:41:38.09	3.888	7.659
581	45.306	17.914	1.395	34.564	13.168	2352442	2467056	5/17/1998	00:47:38.88	4.003	7.656
582	45.298	17.92	1.357	34.551	13.167	2339605	2467423	5/17/1998	00:53:39.67	3.915	7.658
583	45.304	17.916	1.302	34.56	13.172	2325629	2468335	5/17/1998	00:59:40.46	3.819	7.662
584	45.292	17.908	1.339	34.556	13.171	2375801	2467323	5/17/1998	01:05:41.25	4.164	7.658
585	45.291	17.901	1.371	34.561	13.171	2393714	2467936	5/17/1998	01:11:42.04	4.287	7.660
586	45.286	17.897	1.386	34.56	13.17	2344911	2467390	5/17/1998	01:17:42.83	3.952	7.658
587	45.277	17.892	1.328	34.557	13.171	2340091	2467983	5/17/1998	01:23:43.62	3.918	7.660
588	45.27	17.888	1.298	34.555	13.171	2324607	2467197	5/17/1998	01:29:44.41	3.812	7.657
589	45.256	17.871	1.286	34.557	13.17	2354488	2467486	5/17/1998	01:35:45.20	4.017	7.658
590	45.255	17.86	1.32	34.565	13.171	2334609	2466970	5/17/1998	01:41:45.99	3.881	7.656
591	45.249	17.855	1.255	34.564	13.168	2341522	2467301	5/17/1998	01:47:46.78	3.928	7.657
592	45.239	17.851	1.241	34.559	13.169	2357362	2467528	5/17/1998	01:53:47.57	4.037	7.658
593	45.233	17.838	1.227	34.565	13.168	2354461	2466798	5/17/1998	01:59:48.36	4.017	7.655
594	45.227	17.836	1.251	34.562	13.169	2346498	2466464	5/17/1998	02:05:49.15	3.962	7.654
595	45.223	17.818	1.228	34.574	13.169	2329462	2467108	5/17/1998	02:11:49.94	3.846	7.657
596	45.219	17.818	1.168	34.57	13.169	2303440	2467571	5/17/1998	02:17:50.73	3.667	7.659
597	45.215	17.818	1.099	34.567	13.168	2348828	2467607	5/17/1998	02:23:51.52	3.978	7.659
598	45.211	17.813	1.124	34.567	13.167	2315842	2467344	5/17/1998	02:29:52.31	3.752	7.658
599	45.207	17.811	1.113	34.566	13.168	2359304	2466972	5/17/1998	02:35:53.10	4.050	7.656
600	45.204	17.807	1.139	34.567	13.168	2341558	2467290	5/17/1998	02:41:53.89	3.929	7.657
601	45.197	17.797	1.066	34.569	13.166	2339620	2467203	5/17/1998	02:47:54.68	3.915	7.657
602	45.194	17.789	1.033	34.574	13.166	2336496	2467142	5/17/1998	02:53:55.47	3.894	7.657
603	45.197	17.805	1.031	34.562	13.167	2329092	2467169	5/17/1998	02:59:56.26	3.843	7.657
604	45.199	17.806	1.029	34.563	13.165	2345839	2466527	5/17/1998	03:05:57.05	3.958	7.654
605	45.202	17.804	0.98	34.568	13.166	2343813	2467411	5/17/1998	03:11:57.84	3.944	7.658
606	45.197	17.798	0.872	34.569	13.165	2330224	2467036	5/17/1998	03:17:58.63	3.851	7.656
607	45.2	17.804	0.878	34.567	13.164	2355436	2467817	5/17/1998	03:23:59.42	4.024	7.660
608	45.197	17.791	0.884	34.574	13.165	2361804	2467743	5/17/1998	03:30:00.21	4.068	7.659
609	45.202	17.813	0.897	34.56	13.165	2365687	2467669	5/17/1998	03:36:01.00	4.094	7.659
610	45.205	17.797	0.794	34.576	13.166	2321636	2467781	5/17/1998	03:42:01.79	3.792	7.660
611	45.209	17.807	0.795	34.571	13.165	2325346	2467497	5/17/1998	03:48:02.58	3.817	7.658
612	45.208	17.809	0.752	34.569	13.164	2359005	2467658	5/17/1998	03:54:03.37	4.048	7.659
613	45.216	17.817	0.768	34.569	13.164	2343460	2466552	5/17/1998	04:00:04.16	3.942	7.654
614	45.227	17.827	0.71	34.57	13.163	2353426	2467467	5/17/1998	04:06:04.95	4.010	7.658
615	45.235	17.836	0.678	34.569	13.164	2354205	2467116	5/17/1998	04:12:05.74	4.015	7.657
616	45.238	17.832	0.63	34.574	13.164	2310477	2467348	5/17/1998	04:18:06.53	3.715	7.658
617	45.25	17.858	0.668	34.563	13.164	2357586	2467347	5/17/1998	04:24:07.32	4.039	7.658
618	45.256	17.863	0.643	34.564	13.163	2326316	2467019	5/17/1998	04:30:08.11	3.824	7.656
619	45.276	17.877	0.591	34.569	13.164	2348954	2467217	5/17/1998	04:36:08.90	3.979	7.657
620	45.286	17.89	0.51	34.567	13.164	2359153	2466636	5/17/1998	04:42:09.69	4.049	7.655
621	45.285	17.889	0.474	34.567	13.163	2338852	2467149	5/17/1998	04:48:10.48	3.910	7.657
622	45.296	17.897	0.477	34.569	13.162	2306267	2467817	5/17/1998	04:54:11.27	3.686	7.660
623	45.307	17.908	0.463	34.569	13.164	2346058	2467430	5/17/1998	05:00:12.06	3.959	7.658
624	45.323	17.924	0.391	34.569	13.164	2355039	2467178	5/17/1998	05:06:12.85	4.021	7.657
625	45.322	17.934	0.395	34.56	13.162	2359708	2467231	5/17/1998	05:12:13.64	4.053	7.657
626	45.34	17.944	0.344	34.567	13.163	2348177	2467303	5/17/1998	05:18:14.43	3.974	7.657
627	45.352	17.952	0.345	34.57	13.163	2338359	2467454	5/17/1998	05:24:15.22	3.907	7.658
628	45.365	17.973	0.335	34.564	13.163	2335940	2467496	5/17/1998	05:30:16.01	3.890	7.658
629	45.373	17.973	0.273	34.571	13.164	2331284	2467326	5/17/1998	05:36:16.80	3.858	7.658
630	45.38	17.984	0.24	34.567	13.163	2322278	2467280	5/17/1998	05:42:17.59	3.796	7.657
631	45.398	18.004	0.211	34.566	13.164	2350069	2466876	5/17/1998	05:48:18.38	3.987	7.656

Blank Test #2 Sensor Data

Record No.	Conductivity (mS/cm)	Temperature (Deg. C)	Pressure (dBar)	Salinity (PSU)	CTD Bat. (Vdc)	D.O. (Integer)	pH (Integer)	Date	Time	D.O. (ml/L)	pH (Value)
1	46.202	19.133	1.108	34.299	13.16	2390314	2440004	5/21/1998	13:38:51.25	4.263	7.539
2	46.278	19.098	1.076	34.39	13.167	2522865	2451441	5/21/1998	13:45:33.26	5.173	7.589
3	46.316	19.068	1.072	34.448	13.169	2340983	2454720	5/21/1998	13:51:34.06	3.925	7.603
4	46.337	19.061	1.105	34.471	13.172	2509529	2457809	5/21/1998	13:57:34.86	5.081	7.616
5	46.353	19.032	1.159	34.508	13.152	2501876	2458357	5/21/1998	14:03:35.66	5.029	7.619
6	46.359	19.024	1.187	34.52	13.162	2435298	2460954	5/21/1998	14:09:36.46	4.572	7.630
7	46.366	19.012	1.199	34.537	13.163	2427763	2460922	5/21/1998	14:15:37.26	4.520	7.630
8	46.363	19.001	1.208	34.543	13.163	2400872	2461056	5/21/1998	14:21:38.06	4.336	7.630
9	46.358	18.984	1.243	34.553	13.163	2361794	2461934	5/21/1998	14:27:38.86	4.067	7.634
10	46.353	18.964	1.269	34.565	13.162	2458406	2463035	5/21/1998	14:33:39.66	4.730	7.639
11	46.343	18.945	1.304	34.572	13.161	2365812	2463574	5/21/1998	14:39:40.46	4.095	7.641
12	46.334	18.937	1.328	34.571	13.16	2553596	2464094	5/21/1998	14:45:41.26	5.384	7.644
13	46.326	18.932	1.334	34.569	13.16	2584932	2464757	5/21/1998	14:51:42.06	5.599	7.646
14	46.312	18.904	1.444	34.581	13.159	2424556	2465466	5/21/1998	14:57:42.86	4.498	7.649
15	46.281	18.871	1.468	34.582	13.158	2459465	2466503	5/21/1998	15:03:43.66	4.738	7.654
16	46.243	18.838	1.51	34.579	13.159	2454382	2466498	5/21/1998	15:09:44.46	4.703	7.654
17	46.216	18.801	1.53	34.587	13.138	2423580	2466276	5/21/1998	15:15:45.26	4.491	7.653

Record No.	Conductivity (mS/cm)	Temperature (Deg. C)	Pressure (dBar)	Salinity (PSU)	CTD Bat. (Vdc)	D.O. (Integer)	pH (Integer)	Date	Time	D.O. (ml/L)	pH (Value)
18	46.184	18.77	1.512	34.586	13.148	2373287	2467426	5/21/1998	15:21:46.06	4.146	7.658
19	46.158	18.743	1.589	34.586	13.149	2507339	2467756	5/21/1998	15:27:46.86	5.066	7.659
20	46.132	18.708	1.619	34.594	13.15	2505078	2467849	5/21/1998	15:33:47.66	5.051	7.660
21	46.097	18.678	1.619	34.589	13.15	2515458	2467839	5/21/1998	15:39:48.46	5.122	7.660
22	46.072	18.646	1.66	34.596	13.148	2493683	2468153	5/21/1998	15:45:49.26	4.973	7.661
23	46.037	18.618	1.704	34.589	13.148	2533075	2468413	5/21/1998	15:51:50.06	5.243	7.662
24	46.006	18.582	1.735	34.593	13.146	2478840	2469294	5/21/1998	15:57:50.86	4.871	7.666
25	45.967	18.532	1.812	34.602	13.146	2561193	2468621	5/21/1998	16:03:51.66	5.436	7.663
26	45.927	18.502	1.803	34.594	13.146	2552714	2469184	5/21/1998	16:09:52.46	5.378	7.666
27	45.888	18.46	1.839	34.597	13.143	2355165	2470047	5/21/1998	16:15:53.26	4.022	7.669
28	45.854	18.426	1.869	34.597	13.143	2525326	2470359	5/21/1998	16:21:54.06	5.190	7.671
29	45.817	18.388	1.904	34.597	13.146	2458766	2469934	5/21/1998	16:27:54.86	4.733	7.669
30	45.78	18.352	1.956	34.596	13.142	2470958	2470148	5/21/1998	16:33:55.66	4.817	7.670
31	45.746	18.319	1.974	34.595	13.141	2374208	2470550	5/21/1998	16:39:56.46	4.153	7.671
32	45.712	18.289	2.009	34.591	13.14	2437755	2471185	5/21/1998	16:45:57.26	4.589	7.674
33	45.68	18.248	2.023	34.599	13.139	2431687	2470966	5/21/1998	16:51:58.06	4.547	7.673
34	45.645	18.207	2.044	34.604	13.14	2558848	2470882	5/21/1998	16:57:58.86	5.420	7.673
35	45.612	18.179	2.102	34.599	13.136	2413532	2470847	5/21/1998	17:03:59.66	4.423	7.673
36	45.579	18.148	2.085	34.598	13.135	2572176	2470840	5/21/1998	17:10:00.46	5.511	7.673
37	45.549	18.109	2.135	34.605	13.137	2480318	2470963	5/21/1998	17:16:01.26	4.881	7.673
38	45.514	18.078	2.167	34.602	13.135	2536597	2471746	5/21/1998	17:22:02.06	5.267	7.677
39	45.478	18.036	2.189	34.606	13.135	2505750	2471657	5/21/1998	17:28:02.86	5.055	7.676
40	45.442	17.985	2.199	34.618	13.133	2500701	2471833	5/21/1998	17:34:03.66	5.021	7.677
41	45.4	17.956	2.21	34.608	13.131	2525424	2472433	5/21/1998	17:40:04.46	5.190	7.680
42	45.363	17.912	2.26	34.613	13.13	2550208	2472446	5/21/1998	17:46:05.26	5.361	7.680
43	45.327	17.876	2.297	34.613	13.129	2506076	2472325	5/21/1998	17:52:06.06	5.058	7.679
44	45.301	17.852	2.283	34.611	13.129	2418967	2472158	5/21/1998	17:58:06.86	4.460	7.678
45	45.273	17.824	2.272	34.612	13.128	2471378	2472321	5/21/1998	18:04:07.66	4.820	7.679
46	45.246	17.786	2.274	34.621	13.127	2366864	2473064	5/21/1998	18:10:08.46	4.102	7.682
47	45.22	17.77	2.274	34.612	13.127	2485840	2472505	5/21/1998	18:16:09.26	4.919	7.680
48	45.197	17.742	2.307	34.615	13.125	2512483	2472953	5/21/1998	18:22:10.06	5.102	7.682
49	45.164	17.707	2.303	34.618	13.125	2517881	2473129	5/21/1998	18:28:10.86	5.139	7.683
50	45.143	17.691	2.285	34.612	13.124	2461695	2473022	5/21/1998	18:34:11.66	4.753	7.682
51	45.112	17.669	2.343	34.605	13.123	2521923	2473058	5/21/1998	18:40:12.46	5.166	7.682
52	45.091	17.631	2.329	34.619	13.123	2555670	2473504	5/21/1998	18:46:13.26	5.398	7.684
53	45.065	17.619	2.324	34.607	13.122	2530853	2473616	5/21/1998	18:52:14.06	5.228	7.685
54	45.037	17.581	2.304	34.615	13.123	2527753	2473714	5/21/1998	18:58:14.86	5.206	7.685
55	45.012	17.548	2.278	34.622	13.122	2520220	2474142	5/21/1998	19:04:15.66	5.155	7.687
56	44.988	17.534	2.286	34.614	13.122	2488670	2474554	5/21/1998	19:10:16.46	4.938	7.689
57	44.974	17.518	2.273	34.615	13.12	2340159	2473935	5/21/1998	19:16:17.26	3.919	7.686
58	44.958	17.492	2.253	34.624	13.12	2505343	2474372	5/21/1998	19:22:18.06	5.053	7.688
59	44.934	17.483	2.247	34.61	13.124	2499414	2474364	5/21/1998	19:28:18.86	5.012	7.688
60	44.923	17.458	2.259	34.623	13.12	2484125	2474709	5/21/1998	19:34:19.66	4.907	7.689
61	44.911	17.449	2.206	34.62	13.12	2463238	2474635	5/21/1998	19:40:20.46	4.764	7.689
62	44.899	17.426	2.177	34.629	13.119	2382057	2474805	5/21/1998	19:46:21.26	4.207	7.690
63	44.885	17.418	2.161	34.624	13.118	2550609	2474660	5/21/1998	19:52:22.06	5.363	7.689
64	44.864	17.402	2.125	34.619	13.119	2452850	2475328	5/21/1998	19:58:22.86	4.692	7.692
65	44.852	17.389	2.079	34.621	13.118	2539657	2474369	5/21/1998	20:04:23.66	5.288	7.688
66	44.845	17.372	2.096	34.629	13.116	2505340	2474789	5/21/1998	20:10:24.46	5.053	7.690
67	44.826	17.357	2.065	34.625	13.118	2483477	2475315	5/21/1998	20:16:25.26	4.903	7.692
68	44.816	17.358	2.054	34.615	13.117	2546740	2475066	5/21/1998	20:22:26.06	5.337	7.691
69	44.814	17.334	2.003	34.634	13.117	2521575	2475101	5/21/1998	20:28:26.86	5.164	7.691
70	44.796	17.329	1.99	34.623	13.116	2537269	2474887	5/21/1998	20:34:27.66	5.272	7.690
71	44.792	17.321	1.957	34.627	13.113	2514934	2475563	5/21/1998	20:40:28.46	5.118	7.693
72	44.784	17.304	1.888	34.634	13.114	2527107	2475467	5/21/1998	20:47:10.46	5.202	7.693
73	44.773	17.298	1.858	34.63	13.113	2535439	2475272	5/21/1998	20:53:11.26	5.259	7.692
74	44.769	17.301	1.835	34.624	13.111	2491451	2475189	5/21/1998	20:59:12.06	4.957	7.692
75	44.764	17.286	1.795	34.632	13.112	2478345	2476044	5/21/1998	21:05:12.86	4.867	7.695
76	44.747	17.28	1.764	34.623	13.111	2419311	2475569	5/21/1998	21:11:13.66	4.462	7.693
77	44.751	17.269	1.703	34.636	13.109	2489444	2475393	5/21/1998	21:17:14.46	4.944	7.692
78	44.753	17.271	1.71	34.636	13.111	2503768	2476429	5/21/1998	21:23:15.26	5.042	7.697
79	44.752	17.282	1.671	34.625	13.112	2512456	2476399	5/21/1998	21:29:16.06	5.101	7.697
80	44.761	17.285	1.659	34.63	13.11	2506785	2476267	5/21/1998	21:35:16.86	5.063	7.696
81	44.761	17.285	1.563	34.631	13.111	2457003	2475595	5/21/1998	21:41:17.66	4.721	7.693
82	44.767	17.284	1.527	34.637	13.109	2557588	2476434	5/21/1998	21:47:18.46	5.411	7.697
83	44.776	17.3	1.502	34.63	13.109	2509352	2476291	5/21/1998	21:53:19.26	5.080	7.696
84	44.786	17.308	1.449	34.633	13.108	2466104	2476058	5/21/1998	21:59:20.06	4.783	7.695
85	44.791	17.313	1.413	34.633	13.108	2555568	2476098	5/21/1998	22:05:20.86	5.397	7.695
86	44.8	17.335	1.413	34.621	13.108	2519069	2476377	5/21/1998	22:11:21.66	5.147	7.697
87	44.815	17.341	1.374	34.629	13.107	2476979	2476875	5/21/1998	22:17:22.46	4.858	7.699
88	44.834	17.351	1.333	34.637	13.108	2453701	2476864	5/21/1998	22:23:23.26	4.698	7.699
89	44.847	17.377	1.312	34.627	13.108	2508059	2476798	5/21/1998	22:29:24.06	5.071	7.698
90	44.867	17.395	1.276	34.628	13.107	2477922	2476404	5/21/1998	22:35:24.86	4.864	7.697
91	44.871	17.4	1.244	34.627	13.107	2466918	2476771	5/21/1998	22:41:25.66	4.789	7.698
92	44.876	17.406	1.175	34.627	13.108	2458859	2477017	5/21/1998	22:47:26.46	4.734	7.699
93	44.889	17.42	1.137	34.626	13.107	2423035	2476877	5/21/1998	22:53:27.26	4.488	7.699
94	44.887	17.412	1.077	34.63	13.107	2477639	2477159	5/21/1998	22:59:28.06	4.862	7.700
95	44.893	17.408	1.092	34.64	13.107	2463486	2477276	5/21/1998	23:05:28.86	4.765	7.701
96	44.906	17.428	1.052	34.633	13.108	2437951	2476897	5/21/1998	23:11:29.66	4.590	7.699
97	44.912	17.442	1.045	34.627	13.104	2564190	2477004	5/21/1998	23:17:30.46	5.456	7.699
98	44.921	17.451	0.969	34.627	13.105	2505644	2477244	5/21/1998	23:23:31.26	5.055	7.700
99	44.928	17.46	0.961	34.625	13.104	2519770	2476920	5/21/1998	23:29:32.06	5.152	7.699
100	44.939	17.466	0.902	34.63	13.106	2492289	2477066	5/21/1998	23:35:32.86	4.963	7.700
101	44.944	17.481	0.894	34.622	13.107	2474222	2477496	5/21/1998	23:41:33.66	4.839	7.701
102	44.958	17.475	0.867	34.639	13.103	2514833	2476933	5/21/1998	23:47:34.46	5.118	7.699
103	44.977	17.498	0.813	34.635	13.1	2447485	2478166	5/21/1998	23:53:35.26	4.656	7.704
104	45.006	17.533	0.81	34.63	13.1	2394625	2477179	5/21/1998	23:59:36.06	4.293	7.700
105	45.017	17.543	0.778	34.631	13.103	2441267	2476859	5/22/1998	00:05:36.86	4.613	7.699
106	45.057	17.586	0.803	34.629	13.103	2471410	2476729	5/22/1998	00:11:37.66	4.820	7.698
107	45.096	17.624	0.778	34.63	13.103	2515227	2477467	5/22/1998	00:17:38.46	5.120	7.701
108	45.129	17.666	0.731	34.623	13.103	2516008	2477202	5/22/1998	00:23:39.26	5.126	7.700
109	45.172	17.703	0.722	34.628	13.101	2461183	2477837	5/22/1998	00:29:40.06	4.750	7.703
110	45.214	17.742	0.717	34.631	13.103	2439726	2477267	5/22/1998	00:35:40.86	4.602	7.700
111	45.245	17.783	0.723	34.623	13.103	2519799	2477347	5/22/1998	00:41:41.66	5.152	7.701

Record No.	Conductivity (mS/cm)	Temperature (Deg. C)	Pressure (dBar)	Salinity (PSU)	CTD Bat. (Vdc)	D.O. (Integer)	pH (Integer)	Date	Time	D.O. (ml/L)	pH (Value)
112	45.278	17.814	0.702	34.625	13.102	2550837	2477708	5/22/1998	00:47:42.46	5.365	7.702
113	45.313	17.844	0.695	34.629	13.105	2519264	2476562	5/22/1998	00:53:43.26	5.148	7.697
114	45.349	17.886	0.675	34.625	13.102	2427305	2477508	5/22/1998	00:59:44.06	4.517	7.702
115	45.381	17.92	0.666	34.623	13.106	2510104	2477272	5/22/1998	01:05:44.86	5.085	7.701
116	45.409	17.948	0.706	34.623	13.106	2489018	2477992	5/22/1998	01:11:45.66	4.941	7.704
117	45.441	17.989	0.702	34.616	13.107	2559590	2477596	5/22/1998	01:17:46.46	5.425	7.702
118	45.474	18.014	0.676	34.622	13.106	2449186	2477557	5/22/1998	01:23:47.26	4.667	7.702
119	45.497	18.04	0.674	34.62	13.106	2562210	2477342	5/22/1998	01:29:48.06	5.443	7.701
120	45.529	18.062	0.66	34.629	13.106	2526724	2477193	5/22/1998	01:35:48.86	5.199	7.700
121	45.545	18.097	0.685	34.613	13.106	2543469	2477368	5/22/1998	01:41:49.66	5.314	7.701
122	45.573	18.105	0.706	34.629	13.106	2360954	2477673	5/22/1998	01:47:50.46	4.062	7.702
123	45.591	18.129	0.705	34.624	13.104	2533349	2477321	5/22/1998	01:53:51.26	5.245	7.701
124	45.608	18.145	0.715	34.626	13.104	2520575	2477208	5/22/1998	01:59:52.06	5.157	7.700
125	45.621	18.173	0.708	34.613	13.105	2329882	2477674	5/22/1998	02:05:52.86	3.848	7.702
126	45.641	18.176	0.722	34.627	13.104	2547123	2477206	5/22/1998	02:11:53.66	5.339	7.700
127	45.653	18.197	0.763	34.62	13.106	2523985	2477146	5/22/1998	02:17:54.46	5.181	7.700
128	45.66	18.208	0.761	34.616	13.104	2510639	2477250	5/22/1998	02:23:55.26	5.089	7.700
129	45.672	18.225	0.781	34.612	13.104	2556839	2476997	5/22/1998	02:29:56.06	5.406	7.699
130	45.688	18.24	0.798	34.613	13.102	2555538	2477086	5/22/1998	02:35:56.86	5.397	7.700
131	45.697	18.247	0.802	34.615	13.103	2577033	2477383	5/22/1998	02:41:57.66	5.545	7.701
132	45.713	18.261	0.826	34.616	13.104	2538299	2477239	5/22/1998	02:47:58.46	5.279	7.700
133	45.724	18.259	0.866	34.628	13.104	2559382	2477180	5/22/1998	02:53:59.26	5.423	7.700
134	45.738	18.279	0.873	34.623	13.104	2520177	2476853	5/22/1998	03:00:00.06	5.154	7.699
135	45.746	18.298	0.911	34.613	13.103	2462069	2477108	5/22/1998	03:06:00.86	4.756	7.700
136	45.758	18.308	0.906	34.615	13.102	2546888	2476971	5/22/1998	03:12:01.66	5.338	7.699
137	45.77	18.319	0.942	34.615	13.103	2531091	2476808	5/22/1998	03:18:02.46	5.229	7.699
138	45.781	18.33	0.988	34.616	13.101	2552020	2477715	5/22/1998	03:24:03.26	5.373	7.702
139	45.786	18.337	1.017	34.614	13.101	2564959	2477456	5/22/1998	03:30:04.06	5.462	7.701
140	45.798	18.344	1.04	34.619	13.101	2478992	2476837	5/22/1998	03:36:04.86	4.872	7.699
141	45.809	18.358	1.042	34.616	13.101	2531656	2476966	5/22/1998	03:42:05.66	5.233	7.699
142	45.813	18.365	1.081	34.613	13.1	2558407	2477173	5/22/1998	03:48:47.68	5.417	7.700
143	45.824	18.372	1.12	34.617	13.1	2531641	2477906	5/22/1998	03:54:48.48	5.233	7.703
144	45.825	18.376	1.145	34.614	13.1	2540305	2477434	5/22/1998	04:00:49.28	5.293	7.701
145	45.824	18.369	1.168	34.619	13.099	2476107	2477134	5/22/1998	04:06:50.08	4.852	7.700
146	45.808	18.357	1.198	34.616	13.1	2542306	2476991	5/22/1998	04:12:50.88	5.306	7.699
147	45.796	18.346	1.243	34.615	13.098	2491920	2477085	5/22/1998	04:18:51.68	4.960	7.700
148	45.777	18.319	1.283	34.621	13.097	2559809	2477640	5/22/1998	04:24:52.48	5.426	7.702
149	45.753	18.304	1.283	34.614	13.097	2535834	2476651	5/22/1998	04:30:53.28	5.262	7.698
150	45.738	18.286	1.306	34.616	13.097	2546808	2476655	5/22/1998	04:36:54.08	5.337	7.698
151	45.722	18.257	1.345	34.628	13.095	2468557	2477490	5/22/1998	04:42:54.88	4.800	7.701
152	45.701	18.251	1.383	34.614	13.096	2528798	2476453	5/22/1998	04:48:55.68	5.214	7.697
153	45.671	18.217	1.396	34.617	13.095	2517556	2477030	5/22/1998	04:54:56.48	5.136	7.699
154	45.648	18.191	1.405	34.62	13.095	2519308	2477160	5/22/1998	05:00:57.28	5.148	7.700
155	45.627	18.166	1.428	34.623	13.094	2555662	2477278	5/22/1998	05:06:58.08	5.398	7.701
156	45.596	18.152	1.425	34.61	13.093	2513395	2476905	5/22/1998	05:12:58.88	5.108	7.699
157	45.577	18.116	1.464	34.623	13.093	2521306	2476796	5/22/1998	05:18:59.68	5.162	7.698
158	45.558	18.105	1.513	34.616	13.092	2555370	2477149	5/22/1998	05:25:00.48	5.396	7.700
159	45.542	18.092	1.526	34.614	13.093	2553861	2476514	5/22/1998	05:31:01.28	5.386	7.697
160	45.537	18.083	1.524	34.617	13.093	2550637	2476525	5/22/1998	05:37:02.08	5.363	7.697
161	45.524	18.069	1.559	34.618	13.092	2541907	2476470	5/22/1998	05:43:02.88	5.304	7.697
162	45.508	18.054	1.615	34.617	13.091	2523072	2477189	5/22/1998	05:49:03.68	5.174	7.700
163	45.472	18.024	1.665	34.612	13.091	2556613	2477205	5/22/1998	05:55:04.48	5.404	7.700
164	45.458	17.994	1.638	34.625	13.09	2484451	2476845	5/22/1998	06:01:05.28	4.909	7.699
165	45.432	17.967	1.667	34.625	13.089	2464945	2477186	5/22/1998	06:07:06.08	4.775	7.700
166	45.407	17.939	1.632	34.628	13.088	2531457	2476656	5/22/1998	06:13:06.88	5.232	7.698
167	45.386	17.918	1.659	34.628	13.088	2505329	2477277	5/22/1998	06:19:07.68	5.053	7.701
168	45.369	17.909	1.695	34.621	13.089	2498060	2477641	5/22/1998	06:25:08.48	5.003	7.702
169	45.348	17.876	1.674	34.631	13.089	2555347	2476938	5/22/1998	06:31:09.28	5.396	7.699
170	45.313	17.843	1.705	34.629	13.087	2538492	2476915	5/22/1998	06:37:10.08	5.280	7.699
171	45.281	17.812	1.735	34.629	13.086	2542194	2476964	5/22/1998	06:43:10.88	5.306	7.699
172	45.25	17.783	1.751	34.626	13.085	2376488	2477291	5/22/1998	06:49:11.68	4.168	7.701
173	45.209	17.716	1.712	34.649	13.085	2513666	2477088	5/22/1998	06:55:12.48	5.110	7.700
174	45.166	17.693	1.717	34.632	13.085	2480147	2476989	5/22/1998	07:01:13.28	4.880	7.699
175	45.13	17.66	1.679	34.628	13.084	2557294	2476859	5/22/1998	07:07:14.08	5.409	7.699
176	45.098	17.62	1.699	34.635	13.083	2529115	2477376	5/22/1998	07:13:14.88	5.216	7.701
177	45.057	17.587	1.684	34.628	13.082	2532466	2477867	5/22/1998	07:19:15.68	5.239	7.703
178	45.036	17.56	1.704	34.633	13.081	2486409	2477678	5/22/1998	07:25:16.48	4.923	7.702
179	45.011	17.527	1.7	34.639	13.082	2508540	2476940	5/22/1998	07:31:17.28	5.075	7.699
180	44.985	17.508	1.693	34.633	13.082	2521874	2476530	5/22/1998	07:37:18.08	5.166	7.697
181	44.962	17.475	1.653	34.641	13.08	2470629	2476918	5/22/1998	07:43:18.88	4.814	7.699
182	44.935	17.456	1.632	34.634	13.08	2530286	2477282	5/22/1998	07:49:19.68	5.224	7.701
183	44.911	17.436	1.638	34.63	13.08	2497136	2476602	5/22/1998	07:55:20.48	4.996	7.698
184	44.898	17.413	1.607	34.639	13.08	2499170	2476886	5/22/1998	08:01:21.28	5.010	7.699
185	44.885	17.399	1.589	34.64	13.078	2521135	2476775	5/22/1998	08:07:22.08	5.161	7.698
186	44.87	17.388	1.574	34.636	13.079	2520418	2476553	5/22/1998	08:13:22.88	5.156	7.697
187	44.856	17.368	1.555	34.641	13.079	2496176	2476810	5/22/1998	08:19:23.68	4.990	7.699
188	44.838	17.351	1.545	34.641	13.078	2495921	2476436	5/22/1998	08:25:24.48	4.988	7.697
189	44.827	17.338	1.525	34.642	13.076	2499587	2476681	5/22/1998	08:31:25.28	5.013	7.698
190	44.811	17.328	1.497	34.636	13.078	2456752	2476819	5/22/1998	08:37:26.08	4.719	7.699
191	44.799	17.326	1.459	34.628	13.078	2527192	2476673	5/22/1998	08:43:26.88	5.203	7.698
192	44.786	17.299	1.434	34.64	13.076	2544265	2476520	5/22/1998	08:49:27.68	5.320	7.697
193	44.773	17.287	1.378	34.64	13.074	2539162	2477420	5/22/1998	08:55:28.48	5.285	7.701
194	44.767	17.276	1.381	34.643	13.075	2530529	2476615	5/22/1998	09:01:29.28	5.225	7.698
195	44.76	17.276	1.358	34.637	13.074	2554847	2476194	5/22/1998	09:07:30.08	5.392	7.696
196	44.763	17.264	1.315	34.65	13.074	2394760	2476965	5/22/1998	09:13:30.88	4.294	7.699
197	44.752	17.261	1.284	34.643	13.074	2495131	2476273	5/22/1998	09:19:31.68	4.983	7.696
198	44.748	17.268	1.262	34.633	13.074	2522533	2476803	5/22/1998	09:25:32.48	5.171	7.698
199	44.752	17.262	1.209	34.643	13.073	2482657	2476080	5/22/1998	09:31:33.28	4.897	7.695
200	44.753	17.26	1.192	34.645	13.073	2531466	2476243	5/22/1998	09:37:34.08	5.232	7.696
201	44.763	17.272	1.135	34.644	13.072	2478414	2476247	5/22/1998	09:43:34.88	4.868	7.696
202	44.776	17.281	1.113	34.647	13.072	2512870	2476179	5/22/1998	09:49:35.68	5.104	7.696
203	44.782	17.3	1.069	34.636	13.072	2542990	2476101	5/22/1998	09:55:36.48	5.311	7.695
204	44.795	17.303	1.054	34.645	13.073	2514186	2476201	5/22/1998	10:01:37.28	5.113	7.696
205	44.815	17.328	1.03	34.64	13.072	2482869	2475749	5/22/1998	10:07:38.08	4.898	7.694

Record No.	Conductivity (mS/cm)	Temperature (Deg. C)	Pressure (dBar)	Salinity (PSU)	CTD Bat. (Vdc)	D.O. (Integer)	pH (Integer)	Date	Time	D.O. (ml/L)	pH (Value)
206	44.847	17.356	1.009	34.645	13.072	2521376	2476367	5/22/1998	10:13:38.88	5.163	7.697
207	44.879	17.389	0.99	34.644	13.072	2506430	2475594	5/22/1998	10:19:39.68	5.060	7.693
208	44.917	17.419	0.951	34.651	13.074	2501957	2475565	5/22/1998	10:25:40.48	5.029	7.693
209	44.951	17.46	0.973	34.646	13.073	2508257	2476163	5/22/1998	10:31:41.28	5.073	7.696
210	44.978	17.498	0.906	34.636	13.074	2527258	2476195	5/22/1998	10:37:42.08	5.203	7.696
211	45.01	17.53	0.841	34.636	13.074	2520040	2475221	5/22/1998	10:43:42.88	5.153	7.692
212	45.022	17.538	0.817	34.64	13.073	2511075	2476560	5/22/1998	10:50:24.90	5.092	7.697
213	45.043	17.565	0.761	34.634	13.072	2573094	2476536	5/22/1998	10:56:25.70	5.518	7.697
214	45.069	17.588	0.727	34.637	13.072	2553586	2477014	5/22/1998	11:02:26.50	5.384	7.699
215	45.095	17.611	0.737	34.64	13.071	2555903	2476480	5/22/1998	11:08:27.30	5.400	7.697
216	45.117	17.635	0.716	34.639	13.072	2484253	2475660	5/22/1998	11:14:28.10	4.908	7.694
217	45.157	17.669	0.678	34.644	13.07	2479726	2476035	5/22/1998	11:20:28.90	4.877	7.695
218	45.186	17.701	0.649	34.642	13.072	2419273	2476067	5/22/1998	11:26:29.70	4.462	7.695
219	45.2	17.717	0.647	34.64	13.072	2497828	2475766	5/22/1998	11:32:30.50	5.001	7.694
220	45.223	17.742	0.609	34.639	13.072	2519695	2475132	5/22/1998	11:38:31.30	5.151	7.691
221	45.242	17.764	0.579	34.636	13.072	2544067	2474886	5/22/1998	11:44:32.10	5.318	7.690
222	45.253	17.766	0.543	34.644	13.071	2432940	2475029	5/22/1998	11:50:32.90	4.556	7.691
223	45.283	17.8	0.534	34.641	13.071	2537971	2475207	5/22/1998	11:56:33.70	5.277	7.692
224	45.317	17.843	0.501	34.634	13.072	2562296	2475944	5/22/1998	12:02:34.50	5.443	7.695
225	45.348	17.875	0.495	34.633	13.073	2440713	2474609	5/22/1998	12:08:35.30	4.609	7.689
226	45.376	17.893	0.508	34.641	13.072	2602873	2474617	5/22/1998	12:14:36.10	5.722	7.689
227	45.41	17.927	0.487	34.641	13.073	2501132	2473855	5/22/1998	12:20:36.90	5.024	7.686
228	45.438	17.952	0.466	34.644	13.073	2524167	2474290	5/22/1998	12:26:37.70	5.182	7.688
229	45.469	17.987	0.465	34.641	13.073	2536048	2474344	5/22/1998	12:32:38.50	5.263	7.688
230	45.501	18.018	0.43	34.642	13.072	2545965	2474540	5/22/1998	12:38:39.30	5.331	7.689
231	45.532	18.061	0.458	34.632	13.072	2533242	2474607	5/22/1998	12:44:40.10	5.244	7.689
232	45.573	18.097	0.398	34.636	13.074	2542412	2474832	5/22/1998	12:50:40.90	5.307	7.690
233	45.607	18.132	0.424	34.635	13.072	2537286	2475282	5/22/1998	12:56:41.70	5.272	7.692
234	45.649	18.191	0.424	34.621	13.073	2557397	2474541	5/22/1998	13:02:42.50	5.410	7.689
235	45.682	18.208	0.426	34.635	13.075	2572214	2475073	5/22/1998	13:08:43.30	5.512	7.691
236	45.71	18.237	0.444	34.635	13.075	2601694	2475205	5/22/1998	13:14:44.10	5.714	7.692
237	45.738	18.261	0.434	34.638	13.073	2522882	2475577	5/22/1998	13:20:44.90	5.173	7.693
238	45.77	18.288	0.47	34.642	13.074	2566391	2475066	5/22/1998	13:26:45.70	5.472	7.691
239	45.795	18.328	0.452	34.629	13.073	2572739	2475476	5/22/1998	13:32:46.50	5.515	7.693
240	45.821	18.348	0.457	34.635	13.073	2469582	2475410	5/22/1998	13:38:47.30	4.807	7.692
241	45.855	18.386	0.44	34.631	13.072	2546359	2475661	5/22/1998	13:44:48.10	5.334	7.694
242	45.878	18.403	0.449	34.636	13.073	2562619	2475641	5/22/1998	13:50:48.90	5.446	7.693
243	45.896	18.429	0.512	34.63	13.072	2531384	2475645	5/22/1998	13:56:49.70	5.231	7.693
244	45.919	18.447	0.525	34.634	13.073	2586375	2475526	5/22/1998	14:02:50.50	5.609	7.693
245	45.936	18.463	0.523	34.635	13.072	2432841	2476249	5/22/1998	14:08:51.30	4.555	7.696
246	45.956	18.481	0.574	34.637	13.074	2596008	2475959	5/22/1998	14:14:52.10	5.675	7.695
247	45.972	18.506	0.598	34.629	13.074	2559090	2476459	5/22/1998	14:20:52.90	5.421	7.697
248	45.987	18.518	0.618	34.632	13.073	2567108	2475733	5/22/1998	14:26:53.70	5.477	7.694
249	46.011	18.548	0.631	34.627	13.072	2580755	2476464	5/22/1998	14:32:54.50	5.570	7.697
250	46.028	18.555	0.658	34.635	13.071	2590000	2476157	5/22/1998	14:38:55.30	5.634	7.696
251	46.038	18.564	0.668	34.636	13.071	2629935	2476675	5/22/1998	14:44:56.10	5.908	7.698
252	46.051	18.583	0.702	34.631	13.07	2587591	2476883	5/22/1998	14:50:56.90	5.617	7.699
253	46.061	18.593	0.709	34.631	13.071	2554636	2476962	5/22/1998	14:56:57.70	5.391	7.699
254	46.069	18.607	0.741	34.626	13.071	2549037	2477047	5/22/1998	15:02:58.50	5.352	7.700
255	46.083	18.615	0.8	34.631	13.07	2589924	2476830	5/22/1998	15:08:59.30	5.633	7.699
256	46.083	18.617	0.809	34.629	13.071	2532447	2476741	5/22/1998	15:15:00.10	5.239	7.698
257	46.097	18.624	0.848	34.636	13.069	2553231	2477012	5/22/1998	15:21:00.90	5.381	7.699
258	46.104	18.639	0.902	34.629	13.07	2565389	2477423	5/22/1998	15:27:01.70	5.465	7.701
259	46.098	18.63	0.946	34.631	13.07	2535611	2478286	5/22/1998	15:33:02.50	5.260	7.705
260	46.088	18.613	0.971	34.637	13.069	2590498	2478543	5/22/1998	15:39:03.30	5.637	7.706
261	46.065	18.595	0.985	34.632	13.069	2590037	2478087	5/22/1998	15:45:04.10	5.634	7.704
262	46.045	18.573	1.009	34.634	13.069	2567389	2478166	5/22/1998	15:51:04.90	5.478	7.704
263	46.024	18.551	1.03	34.636	13.066	2563393	2478502	5/22/1998	15:57:05.70	5.451	7.706
264	46.002	18.529	1.044	34.635	13.066	2615503	2477569	5/22/1998	16:03:06.50	5.809	7.702
265	45.98	18.504	1.101	34.637	13.066	2611635	2477929	5/22/1998	16:09:07.30	5.782	7.703
266	45.959	18.483	1.186	34.637	13.064	2531634	2478889	5/22/1998	16:15:08.10	5.233	7.707
267	45.935	18.458	1.236	34.639	13.064	2615934	2478497	5/22/1998	16:21:08.90	5.812	7.706
268	45.911	18.434	1.249	34.638	13.064	2617829	2478638	5/22/1998	16:27:09.70	5.825	7.706
269	45.882	18.407	1.26	34.636	13.062	2568530	2479045	5/22/1998	16:33:10.50	5.486	7.708
270	45.854	18.375	1.314	34.64	13.062	2598543	2478537	5/22/1998	16:39:11.30	5.692	7.706
271	45.819	18.346	1.34	34.634	13.062	2552557	2478703	5/22/1998	16:45:12.10	5.377	7.707
272	45.784	18.309	1.384	34.636	13.06	2549410	2478786	5/22/1998	16:51:12.90	5.355	7.707
273	45.753	18.274	1.421	34.64	13.061	2590254	2478743	5/22/1998	16:57:13.70	5.635	7.707
274	45.718	18.239	1.462	34.639	13.061	2545525	2479306	5/22/1998	17:03:14.50	5.328	7.709
275	45.687	18.202	1.505	34.644	13.059	2555879	2479001	5/22/1998	17:09:15.30	5.399	7.708
276	45.649	18.156	1.511	34.651	13.058	2579929	2478432	5/22/1998	17:15:16.10	5.565	7.706
277	45.622	18.129	1.547	34.65	13.057	2555170	2478719	5/22/1998	17:21:16.90	5.395	7.707
278	45.583	18.093	1.532	34.648	13.057	2577298	2479581	5/22/1998	17:27:17.70	5.546	7.710
279	45.554	18.063	1.618	34.648	13.057	2600785	2479058	5/22/1998	17:33:18.50	5.708	7.708
280	45.521	18.033	1.604	34.646	13.056	2555234	2479098	5/22/1998	17:39:19.30	5.395	7.708
281	45.491	18.005	1.644	34.644	13.056	2531467	2479407	5/22/1998	17:45:20.10	5.232	7.710
282	45.453	17.96	1.676	34.649	13.055	2547282	2479640	5/22/1998	17:52:02.15	5.340	7.711
283	45.421	17.91	1.711	34.665	13.055	2540432	2479686	5/22/1998	17:58:02.95	5.293	7.711
284	45.378	17.877	1.752	34.656	13.054	2560748	2479403	5/22/1998	18:04:03.75	5.433	7.710
285	45.333	17.833	1.743	34.656	13.053	2538473	2479535	5/22/1998	18:10:04.55	5.280	7.710
286	45.291	17.789	1.756	34.656	13.052	2541569	2479947	5/22/1998	18:16:05.35	5.301	7.712
287	45.255	17.758	1.784	34.652	13.051	2518730	2479962	5/22/1998	18:22:06.15	5.144	7.712
288	45.206	17.699	1.795	34.661	13.05	2581636	2480060	5/22/1998	18:28:06.95	5.576	7.713
289	45.156	17.645	1.831	34.664	13.048	2522983	2479464	5/22/1998	18:34:07.75	5.174	7.710
290	45.1	17.594	1.863	34.659	13.049	2551811	2479704	5/22/1998	18:40:08.55	5.372	7.711
291	45.057	17.553	1.832	34.657	13.048	2555795	2480717	5/22/1998	18:46:09.35	5.399	7.715
292	45.013	17.51	1.848	34.656	13.047	2572267	2479715	5/22/1998	18:52:10.15	5.512	7.711
293	44.968	17.463	1.819	34.656	13.047	2562524	2480199	5/22/1998	18:58:10.95	5.445	7.713
294	44.94	17.433	1.844	34.658	13.046	2527876	2480112	5/22/1998	19:04:11.75	5.207	7.713
295	44.907	17.377	1.85	34.678	13.047	2528236	2480174	5/22/1998	19:10:12.55	5.210	7.713
296	44.879	17.366	1.904	34.663	13.047	2536020	2480288	5/22/1998	19:16:13.35	5.263	7.714
297	44.858	17.339	1.915	34.668	13.047	2530089	2481096	5/22/1998	19:22:14.15	5.222	7.717
298	44.835	17.313	1.881	34.67	13.045	2501618	2480710	5/22/1998	19:28:14.95	5.027	7.715
299	44.804	17.292	1.841	34.662	13.044	2516179	2480394	5/22/1998	19:34:15.75	5.127	7.714

Record No.	Conductivity (mS/cm)	Temperature (Deg. C)	Pressure (dBar)	Salinity (PSU)	CTD Bat. (Vdc)	D.O. (Integer)	pH (Integer)	Date	Time	D.O. (ml/L)	pH (Value)
300	44.787	17.259	1.846	34.675	13.046	2494858	2480956	5/22/1998	19:40:16.55	4.981	7.716
301	44.756	17.239	1.801	34.666	13.047	2544731	2479916	5/22/1998	19:46:17.35	5.323	7.712
302	44.735	17.216	1.817	34.667	13.043	2517467	2480882	5/22/1998	19:52:18.15	5.136	7.716
303	44.716	17.205	1.779	34.66	13.045	2549646	2480589	5/22/1998	19:58:18.95	5.357	7.715
304	44.695	17.163	1.791	34.678	13.043	2521162	2480455	5/22/1998	20:04:19.75	5.161	7.714
305	44.676	17.143	1.777	34.679	13.042	2518000	2480039	5/22/1998	20:10:20.55	5.139	7.712
306	44.657	17.115	1.799	34.687	13.042	2574959	2479869	5/22/1998	20:16:21.35	5.530	7.712
307	44.636	17.103	1.73	34.678	13.041	2532930	2480393	5/22/1998	20:22:22.15	5.242	7.714
308	44.614	17.089	1.688	34.671	13.043	2532986	2479990	5/22/1998	20:28:22.95	5.242	7.712
309	44.595	17.058	1.643	34.682	13.04	2517637	2480252	5/22/1998	20:34:23.75	5.137	7.713
310	44.572	17.057	1.645	34.662	13.04	2465567	2480180	5/22/1998	20:40:24.55	4.780	7.713
311	44.563	17.021	1.581	34.686	13.039	2502866	2480502	5/22/1998	20:46:25.35	5.036	7.714
312	44.553	17.018	1.578	34.679	13.039	2543391	2480776	5/22/1998	20:52:26.15	5.314	7.716
313	44.534	16.996	1.56	34.682	13.039	2492834	2480874	5/22/1998	20:58:26.95	4.967	7.716
314	44.532	16.991	1.518	34.685	13.04	2484181	2480518	5/22/1998	21:04:27.75	4.907	7.715
315	44.519	16.989	1.472	34.674	13.041	2551100	2480860	5/22/1998	21:10:28.55	5.367	7.716
316	44.505	16.975	1.414	34.674	13.038	2534409	2480932	5/22/1998	21:16:29.35	5.252	7.716
317	44.494	16.962	1.39	34.676	13.038	2503673	2481790	5/22/1998	21:22:30.15	5.041	7.720
318	44.487	16.96	1.336	34.672	13.038	2505018	2480901	5/22/1998	21:28:30.95	5.050	7.716
319	44.476	16.944	1.304	34.676	13.037	2527721	2481551	5/22/1998	21:34:31.75	5.206	7.719
320	44.473	16.942	1.288	34.676	13.038	2497366	2482178	5/22/1998	21:40:32.55	4.998	7.722
321	44.471	16.933	1.222	34.681	13.037	2540504	2480869	5/22/1998	21:46:33.35	5.294	7.716
322	44.464	16.927	1.178	34.681	13.037	2500477	2481066	5/22/1998	21:52:34.15	5.019	7.717
323	44.472	16.933	1.132	34.683	13.037	2493677	2480772	5/22/1998	21:58:34.95	4.973	7.716
324	44.471	16.932	1.084	34.682	13.037	2555636	2481482	5/22/1998	22:04:35.75	5.398	7.719
325	44.475	16.937	1.059	34.681	13.036	2541651	2482014	5/22/1998	22:10:36.55	5.302	7.721
326	44.48	16.94	0.999	34.683	13.039	2510246	2481305	5/22/1998	22:16:37.35	5.086	7.718
327	44.486	16.947	0.937	34.683	13.035	2502953	2481824	5/22/1998	22:22:38.15	5.036	7.720
328	44.503	16.959	0.901	34.687	13.036	2551338	2481762	5/22/1998	22:28:38.95	5.368	7.720
329	44.518	16.966	0.866	34.693	13.036	2549862	2481929	5/22/1998	22:34:39.75	5.358	7.721
330	44.54	17.007	0.831	34.678	13.035	2565331	2481888	5/22/1998	22:40:40.55	5.464	7.720
331	44.567	17.032	0.778	34.68	13.036	2511606	2481505	5/22/1998	22:46:41.35	5.096	7.719
332	44.599	17.056	0.721	34.687	13.036	2563539	2481368	5/22/1998	22:52:42.15	5.452	7.718
333	44.617	17.088	0.671	34.675	13.036	2572075	2481500	5/22/1998	22:58:42.95	5.511	7.719
334	44.662	17.121	0.634	34.686	13.036	2522143	2481644	5/22/1998	23:04:43.75	5.168	7.719
335	44.694	17.157	0.625	34.683	13.036	2498086	2482211	5/22/1998	23:10:44.55	5.003	7.722
336	44.723	17.191	0.594	34.678	13.037	2529994	2481445	5/22/1998	23:16:45.35	5.222	7.719
337	44.756	17.212	0.533	34.689	13.036	2505395	2481385	5/22/1998	23:22:46.15	5.053	7.718
338	44.786	17.255	0.486	34.678	13.036	2516920	2481856	5/22/1998	23:28:46.95	5.132	7.720
339	44.812	17.279	0.439	34.681	13.036	2528784	2481838	5/22/1998	23:34:47.75	5.213	7.720
340	44.842	17.318	0.403	34.673	13.037	2541116	2481893	5/22/1998	23:40:48.55	5.298	7.720
341	44.886	17.352	0.364	34.682	13.037	2524601	2481596	5/22/1998	23:46:49.35	5.185	7.719
342	44.91	17.386	0.315	34.673	13.04	2480835	2481857	5/22/1998	23:52:50.15	4.884	7.720
343	44.917	17.392	0.296	34.674	13.037	2529532	2481861	5/22/1998	23:58:50.95	5.219	7.720
344	44.946	17.418	0.253	34.678	13.036	2512864	2481803	5/23/1998	00:04:51.75	5.104	7.720
345	44.989	17.47	0.239	34.669	13.036	2486088	2481248	5/23/1998	00:10:52.55	4.920	7.718
346	45.025	17.513	0.2	34.664	13.037	2530735	2482099	5/23/1998	00:16:53.35	5.227	7.721
347	45.072	17.544	0.171	34.678	13.038	2567634	2481896	5/23/1998	00:22:54.15	5.480	7.720
348	45.111	17.585	0.127	34.676	13.039	2596736	2481618	5/23/1998	00:28:54.95	5.680	7.719
349	45.138	17.614	0.102	34.675	13.039	2544673	2481384	5/23/1998	00:34:55.75	5.323	7.718
350	45.154	17.637	0.053	34.669	13.037	2516014	2481507	5/23/1998	00:40:56.55	5.126	7.719
351	45.188	17.661	0.039	34.677	13.038	2546135	2481698	5/23/1998	00:46:57.35	5.333	7.720
352	45.223	17.703	0.014	34.672	13.037	2526513	2481972	5/23/1998	00:53:39.39	5.198	7.721
353	45.269	17.741	0	34.68	13.037	2555885	2482028	5/23/1998	00:59:40.19	5.399	7.721
354	45.306	17.783	-0.014	34.675	13.038	2590430	2481398	5/23/1998	01:05:40.99	5.637	7.718
355	45.333	17.823	-0.037	34.665	13.038	2553058	2481499	5/23/1998	01:11:41.79	5.380	7.719
356	45.366	17.854	-0.062	34.666	13.039	2526912	2481095	5/23/1998	01:17:42.59	5.201	7.717
357	45.404	17.884	-0.071	34.673	13.038	2540613	2481352	5/23/1998	01:23:43.39	5.295	7.718
358	45.452	17.934	-0.095	34.672	13.038	2556517	2482037	5/23/1998	01:29:44.19	5.404	7.721
359	45.495	17.976	-0.105	34.673	13.038	2548104	2481425	5/23/1998	01:35:44.99	5.346	7.718
360	45.531	18.013	-0.117	34.672	13.039	2592367	2481265	5/23/1998	01:41:45.79	5.650	7.718
361	45.565	18.058	-0.109	34.662	13.038	2556901	2481470	5/23/1998	01:47:46.59	5.406	7.719
362	45.606	18.087	-0.102	34.673	13.039	2498739	2481178	5/23/1998	01:53:47.39	5.007	7.717
363	45.638	18.128	-0.099	34.665	13.04	2560534	2480973	5/23/1998	01:59:48.19	5.431	7.716
364	45.68	18.162	-0.094	34.673	13.04	2512583	2481180	5/23/1998	02:05:48.99	5.102	7.717
365	45.709	18.19	-0.12	34.674	13.04	2564208	2481543	5/23/1998	02:11:49.79	5.457	7.719
366	45.746	18.229	-0.131	34.672	13.039	2543685	2480836	5/23/1998	02:17:50.59	5.316	7.716
367	45.778	18.264	-0.101	34.67	13.038	2568551	2481195	5/23/1998	02:23:51.39	5.486	7.717
368	45.805	18.29	-0.099	34.67	13.041	2560673	2480921	5/23/1998	02:29:52.19	5.432	7.716
369	45.836	18.326	-0.105	34.666	13.038	2558218	2480783	5/23/1998	02:35:52.99	5.416	7.716
370	45.857	18.351	-0.102	34.663	13.04	2545895	2481259	5/23/1998	02:41:53.79	5.331	7.718
371	45.876	18.374	-0.055	34.659	13.04	2599323	2481012	5/23/1998	02:47:54.59	5.698	7.717
372	45.91	18.405	-0.045	34.662	13.04	2545121	2480984	5/23/1998	02:53:55.39	5.326	7.717
373	45.934	18.43	-0.026	34.661	13.038	2522353	2480654	5/23/1998	02:59:56.19	5.169	7.715
374	45.953	18.453	-0.013	34.658	13.04	2590378	2481112	5/23/1998	03:05:56.99	5.636	7.717
375	45.973	18.47	-0.011	34.66	13.04	2548980	2481494	5/23/1998	03:11:57.79	5.352	7.719
376	45.995	18.487	0.016	34.665	13.039	2479335	2481220	5/23/1998	03:17:58.59	4.874	7.718
377	46.02	18.506	0.075	34.67	13.04	2602047	2480708	5/23/1998	03:23:59.39	5.716	7.715
378	46.041	18.544	0.104	34.655	13.04	2540454	2481055	5/23/1998	03:30:00.19	5.294	7.717
379	46.061	18.567	0.104	34.653	13.038	2556218	2480031	5/23/1998	03:36:00.99	5.402	7.712
380	46.083	18.58	0.105	34.661	13.039	2550058	2480823	5/23/1998	03:42:01.79	5.359	7.716
381	46.1	18.601	0.158	34.657	13.04	2565084	2480477	5/23/1998	03:48:02.59	5.463	7.714
382	46.125	18.62	0.198	34.663	13.041	2541682	2480354	5/23/1998	03:54:03.39	5.302	7.714
383	46.144	18.639	0.229	34.662	13.04	2560697	2480492	5/23/1998	04:00:04.19	5.433	7.714
384	46.156	18.647	0.264	34.666	13.041	2593683	2480358	5/23/1998	04:06:04.99	5.659	7.714
385	46.168	18.667	0.274	34.659	13.039	2549187	2480180	5/23/1998	04:12:05.79	5.354	7.713
386	46.183	18.689	0.325	34.653	13.037	2614653	2479799	5/23/1998	04:18:06.59	5.803	7.711
387	46.199	18.697	0.367	34.66	13.041	2551814	2479998	5/23/1998	04:24:07.39	5.372	7.712
388	46.205	18.705	0.403	34.658	13.036	2572861	2480206	5/23/1998	04:30:08.19	5.516	7.713
389	46.206	18.702	0.426	34.662	13.037	2581931	2480111	5/23/1998	04:36:08.99	5.578	7.713
390	46.196	18.701	0.443	34.654	13.036	2566662	2479960	5/23/1998	04:42:09.79	5.473	7.712
391	46.181	18.681	0.466	34.658	13.041	2544687	2480039	5/23/1998	04:48:10.59	5.323	7.712
392	46.173	18.671	0.51	34.659	13.037	2605728	2480230	5/23/1998	04:54:11.39	5.742	7.713
393	46.152	18.655	0.554	34.656	13.037	2603563	2479793	5/23/1998	05:00:12.19	5.727	7.711

Record No.	Conductivity (mS/cm)	Temperature (Deg. C)	Pressure (dBar)	Salinity (PSU)	CTD Bat. (Vdc)	D.O. (Integer)	pH (Integer)	Date	Time	D.O. (ml/L)	pH (Value)
394	46.141	18.635	0.57	34.664	13.034	2567619	2480371	5/23/1998	05:06:12.99	5.480	7.714
395	46.12	18.621	0.622	34.657	13.034	2580806	2479782	5/23/1998	05:12:13.79	5.571	7.711
396	46.103	18.604	0.649	34.657	13.035	2556223	2480113	5/23/1998	05:18:14.59	5.402	7.713
397	46.087	18.584	0.708	34.66	13.034	2573353	2479766	5/23/1998	05:24:15.39	5.519	7.711
398	46.068	18.562	0.727	34.663	13.033	2546761	2479405	5/23/1998	05:30:16.19	5.337	7.710
399	46.053	18.553	0.747	34.657	13.033	2543820	2480263	5/23/1998	05:36:16.99	5.317	7.713
400	46.042	18.531	0.758	34.667	13.032	2560063	2478851	5/23/1998	05:42:17.79	5.428	7.707
401	46.025	18.518	0.807	34.664	13.032	2552301	2479747	5/23/1998	05:48:18.59	5.375	7.711
402	45.994	18.496	0.828	34.656	13.032	2570116	2479852	5/23/1998	05:54:19.39	5.497	7.712
403	45.97	18.469	0.86	34.659	13.032	2543335	2479850	5/23/1998	06:00:20.19	5.313	7.712
404	45.952	18.441	0.904	34.666	13.031	2525443	2479693	5/23/1998	06:06:20.99	5.191	7.711
405	45.93	18.418	0.93	34.667	13.031	2558889	2479306	5/23/1998	06:12:21.79	5.420	7.709
406	45.908	18.395	0.97	34.669	13.029	2553385	2479460	5/23/1998	06:18:22.59	5.382	7.710
407	45.881	18.376	0.974	34.662	13.029	2600458	2479745	5/23/1998	06:24:23.39	5.705	7.711
408	45.861	18.354	1.024	34.663	13.03	2569088	2479341	5/23/1998	06:30:24.19	5.490	7.709
409	45.843	18.337	1.019	34.663	13.029	2526933	2479083	5/23/1998	06:36:24.99	5.201	7.708
410	45.816	18.304	1.004	34.667	13.028	2537581	2479577	5/23/1998	06:42:25.79	5.274	7.710
411	45.799	18.277	1.03	34.676	13.031	2599347	2479143	5/23/1998	06:48:26.59	5.698	7.709
412	45.78	18.265	1.097	34.67	13.027	2554368	2479341	5/23/1998	06:54:27.39	5.389	7.709
413	45.749	18.235	1.118	34.668	13.025	2525123	2479203	5/23/1998	07:00:28.19	5.188	7.709
414	45.705	18.198	1.132	34.663	13.025	2519614	2479449	5/23/1998	07:06:28.99	5.151	7.710
415	45.682	18.167	1.151	34.669	13.025	2533448	2479207	5/23/1998	07:12:29.79	5.246	7.709
416	45.654	18.141	1.143	34.667	13.026	2555954	2479500	5/23/1998	07:18:30.59	5.400	7.710
417	45.633	18.115	1.157	34.672	13.025	2430381	2479267	5/23/1998	07:24:31.39	4.538	7.709
418	45.608	18.09	1.174	34.672	13.024	2501958	2478975	5/23/1998	07:30:32.19	5.029	7.708
419	45.584	18.07	1.17	34.668	13.023	2524197	2479309	5/23/1998	07:36:32.99	5.182	7.709
420	45.549	18.033	1.186	34.67	13.022	2517803	2478930	5/23/1998	07:42:33.79	5.138	7.708
421	45.526	17.996	1.168	34.682	13.021	2518339	2478972	5/23/1998	07:48:34.59	5.142	7.708
422	45.486	17.966	1.173	34.673	13.021	2552188	2478608	5/23/1998	07:55:16.65	5.374	7.706
423	45.457	17.929	1.192	34.679	13.021	2544192	2479825	5/23/1998	08:01:17.45	5.319	7.712
424	45.422	17.907	1.171	34.668	13.022	2536213	2479450	5/23/1998	08:07:18.25	5.264	7.710
425	45.399	17.872	1.178	34.678	13.019	2519791	2479019	5/23/1998	08:13:19.05	5.152	7.708
426	45.369	17.838	1.173	34.682	13.02	2557432	2478595	5/23/1998	08:19:19.85	5.410	7.706
427	45.345	17.817	1.189	34.68	13.02	2507943	2479244	5/23/1998	08:25:20.65	5.070	7.709
428	45.328	17.792	1.144	34.686	13.02	2501972	2478712	5/23/1998	08:31:21.45	5.029	7.707
429	45.312	17.785	1.122	34.678	13.018	2550992	2479040	5/23/1998	08:37:22.25	5.366	7.708
430	45.29	17.76	1.123	34.681	13.017	2534530	2478846	5/23/1998	08:43:23.05	5.253	7.707
431	45.274	17.738	1.118	34.686	13.019	2591470	2478496	5/23/1998	08:49:23.85	5.644	7.706
432	45.255	17.731	1.101	34.675	13.017	2521083	2478329	5/23/1998	08:55:24.65	5.161	7.705
433	45.239	17.706	1.057	34.684	13.017	2508457	2478320	5/23/1998	09:01:25.45	5.074	7.705
434	45.232	17.701	1.037	34.681	13.017	2506494	2478702	5/23/1998	09:07:26.25	5.061	7.707
435	45.219	17.691	1.023	34.679	13.019	2531824	2479250	5/23/1998	09:13:27.05	5.234	7.709
436	45.209	17.68	1.041	34.68	13.018	2517963	2478876	5/23/1998	09:19:27.85	5.139	7.707
437	45.196	17.671	1.002	34.676	13.016	2528560	2478525	5/23/1998	09:25:28.65	5.212	7.706
438	45.181	17.645	0.956	34.685	13.015	2565673	2478672	5/23/1998	09:31:29.45	5.467	7.707
439	45.164	17.633	0.911	34.681	13.017	2546406	2478298	5/23/1998	09:37:30.25	5.334	7.705
440	45.148	17.624	0.909	34.674	13.014	2517827	2479205	5/23/1998	09:43:31.05	5.138	7.709
441	45.132	17.594	0.92	34.686	13.014	2531457	2478239	5/23/1998	09:49:31.85	5.232	7.705
442	45.123	17.586	0.88	34.685	13.014	2512794	2478250	5/23/1998	09:55:32.65	5.104	7.705
443	45.11	17.578	0.822	34.681	13.016	2548249	2478050	5/23/1998	10:01:33.45	5.347	7.704
444	45.102	17.569	0.779	34.682	13.014	2534234	2478375	5/23/1998	10:07:34.25	5.251	7.705
445	45.089	17.56	0.737	34.679	13.014	2516836	2478096	5/23/1998	10:13:35.05	5.131	7.704
446	45.091	17.56	0.71	34.68	13.015	2518174	2477505	5/23/1998	10:19:35.85	5.141	7.702
447	45.081	17.547	0.68	34.683	13.013	2514741	2478221	5/23/1998	10:25:36.65	5.117	7.705
448	45.079	17.539	0.609	34.689	13.013	2500781	2477760	5/23/1998	10:31:37.45	5.021	7.703
449	45.072	17.536	0.548	34.685	13.012	2534647	2477540	5/23/1998	10:37:38.25	5.254	7.702
450	45.079	17.543	0.58	34.685	13.013	2563901	2477984	5/23/1998	10:43:39.05	5.455	7.704
451	45.093	17.551	0.558	34.69	13.013	2524513	2478610	5/23/1998	10:49:39.85	5.184	7.706
452	45.11	17.575	0.526	34.685	13.013	2478230	2478030	5/23/1998	10:55:40.65	4.867	7.704
453	45.128	17.593	0.549	34.684	13.013	2582847	2477865	5/23/1998	11:01:41.45	5.585	7.703
454	45.141	17.612	0.458	34.679	13.013	2525097	2477944	5/23/1998	11:07:42.25	5.188	7.703
455	45.17	17.637	0.44	34.683	13.013	2527647	2477413	5/23/1998	11:13:43.05	5.206	7.701
456	45.188	17.662	0.407	34.677	13.014	2557564	2477671	5/23/1998	11:19:43.85	5.411	7.702
457	45.217	17.691	0.357	34.678	13.015	2525942	2477373	5/23/1998	11:25:44.65	5.194	7.701
458	45.231	17.701	0.294	34.68	13.013	2556153	2477652	5/23/1998	11:31:45.45	5.401	7.702
459	45.248	17.713	0.292	34.685	13.014	2569279	2476591	5/23/1998	11:37:46.25	5.491	7.698
460	45.269	17.729	0.259	34.689	13.014	2509790	2477083	5/23/1998	11:43:47.05	5.083	7.700
461	45.292	17.767	0.257	34.677	13.013	2512965	2476853	5/23/1998	11:49:47.85	5.105	7.699
462	45.305	17.777	0.242	34.679	13.014	2566893	2476984	5/23/1998	11:55:48.65	5.475	7.699
463	45.313	17.782	0.142	34.681	13.012	2525979	2477031	5/23/1998	12:01:49.45	5.194	7.699
464	45.329	17.8	0.128	34.68	13.014	2525679	2476737	5/23/1998	12:07:50.25	5.192	7.698
465	45.348	17.825	0.134	34.676	13.013	2550772	2477175	5/23/1998	12:13:51.05	5.364	7.700
466	45.379	17.847	0.122	34.683	13.014	2547300	2476558	5/23/1998	12:19:51.85	5.341	7.697
467	45.405	17.873	0.097	34.683	13.016	2571228	2476897	5/23/1998	12:25:52.65	5.505	7.699
468	45.425	17.885	0.063	34.691	13.014	2547223	2476299	5/23/1998	12:31:53.45	5.340	7.696
469	45.445	17.919	0.069	34.678	13.014	2578308	2476455	5/23/1998	12:37:54.25	5.553	7.697
470	45.475	17.948	0.017	34.679	13.016	2559621	2476264	5/23/1998	12:43:55.05	5.425	7.696
471	45.505	17.976	0	34.681	13.015	2570899	2477794	5/23/1998	12:49:55.85	5.503	7.703
472	45.537	18.009	0.002	34.681	13.015	2545682	2476519	5/23/1998	12:55:56.65	5.329	7.697
473	45.553	18.036	-0.023	34.671	13.016	2582263	2476201	5/23/1998	13:01:57.45	5.581	7.696
474	45.589	18.062	-0.049	34.679	13.014	2531513	2476566	5/23/1998	13:07:58.25	5.232	7.697
475	45.624	18.097	-0.037	34.68	13.014	2573840	2477014	5/23/1998	13:13:59.05	5.523	7.699
476	45.647	18.124	-0.048	34.676	13.015	2583203	2476824	5/23/1998	13:19:59.85	5.587	7.699
477	45.675	18.148	-0.068	34.68	13.015	2518249	2476829	5/23/1998	13:26:00.65	5.141	7.699
478	45.706	18.187	-0.057	34.673	13.014	2553641	2477265	5/23/1998	13:32:01.45	5.384	7.700
479	45.745	18.223	-0.059	34.676	13.017	2569545	2476364	5/23/1998	13:38:02.25	5.493	7.697
480	45.779	18.252	-0.045	34.681	13.016	2481423	2476294	5/23/1998	13:44:03.05	4.888	7.696
481	45.808	18.287	-0.065	34.676	13.016	2595313	2476444	5/23/1998	13:50:03.85	5.670	7.697
482	45.847	18.32	-0.043	34.681	13.017	2582524	2477134	5/23/1998	13:56:04.65	5.582	7.700
483	45.886	18.365	-0.057	34.675	13.018	2575951	2476881	5/23/1998	14:02:05.45	5.537	7.699
484	45.915	18.405	-0.051	34.666	13.016	2563593	2477154	5/23/1998	14:08:06.25	5.452	7.700
485	45.93	18.42	-0.059	34.666	13.016	2535607	2477318	5/23/1998	14:14:07.05	5.260	7.701
486	45.977	18.456	-0.038	34.676	13.015	2637619	2477696	5/23/1998	14:20:07.85	5.960	7.702
487	46.01	18.493	-0.002	34.673	13.016	2545646	2477409	5/23/1998	14:26:08.65	5.329	7.701

Record No.	Conductivity (mS/cm)	Temperature (Deg. C)	Pressure (dBar)	Salinity (PSU)	CTD Bat. (Vdc)	D.O. (Integer)	pH (Integer)	Date	Time	D.O. (ml/L)	pH (Value)
488	46.045	18.535	0.016	34.666	13.016	2557096	2477579	5/23/1998	14:32:09.45	5.408	7.702
489	46.081	18.572	0.034	34.666	13.017	2599859	2477999	5/23/1998	14:38:10.25	5.701	7.704
490	46.114	18.602	0.052	34.668	13.018	2561174	2477664	5/23/1998	14:44:11.05	5.436	7.702
491	46.149	18.63	0.096	34.675	13.016	2600665	2478497	5/23/1998	14:50:11.85	5.707	7.706
492	46.171	18.66	0.11	34.667	13.015	2615404	2478598	5/23/1998	14:56:53.91	5.808	7.706
493	46.203	18.688	0.1	34.67	13.016	2574101	2478563	5/23/1998	15:02:54.71	5.525	7.706
494	46.221	18.709	0.116	34.668	13.015	2588684	2479002	5/23/1998	15:08:55.51	5.625	7.708
495	46.244	18.737	0.14	34.664	13.017	2612098	2478674	5/23/1998	15:14:56.31	5.785	7.707
496	46.259	18.748	0.193	34.667	13.015	2611134	2478829	5/23/1998	15:20:57.11	5.779	7.707
497	46.272	18.753	0.224	34.674	13.014	2568264	2479249	5/23/1998	15:26:57.91	5.484	7.709
498	46.28	18.768	0.265	34.668	13.016	2608994	2478914	5/23/1998	15:32:58.71	5.764	7.708
499	46.29	18.774	0.275	34.672	13.015	2619546	2478946	5/23/1998	15:38:59.51	5.836	7.708
500	46.292	18.786	0.334	34.663	13.014	2614175	2479754	5/23/1998	15:45:00.31	5.800	7.711
501	46.309	18.791	0.381	34.673	13.015	2590866	2479348	5/23/1998	15:51:01.11	5.640	7.709
502	46.313	18.792	0.395	34.675	13.016	2585067	2480068	5/23/1998	15:57:01.91	5.600	7.713
503	46.309	18.796	0.412	34.669	13.015	2602026	2479585	5/23/1998	16:03:02.71	5.716	7.710
504	46.319	18.8	0.431	34.674	13.015	2613919	2479851	5/23/1998	16:09:03.51	5.798	7.712
505	46.32	18.797	0.487	34.678	13.014	2576471	2479816	5/23/1998	16:15:04.31	5.541	7.711
506	46.311	18.789	0.498	34.676	13.013	2618894	2480055	5/23/1998	16:21:05.11	5.832	7.713
507	46.286	18.777	0.559	34.666	13.013	2574140	2480093	5/23/1998	16:27:05.91	5.525	7.713
508	46.269	18.747	0.587	34.676	13.012	2615854	2480015	5/23/1998	16:33:06.71	5.811	7.712
509	46.245	18.723	0.636	34.677	13.013	2580148	2480444	5/23/1998	16:39:07.51	5.566	7.714
510	46.224	18.703	0.695	34.676	13.011	2573582	2480412	5/23/1998	16:45:08.31	5.521	7.714
511	46.195	18.677	0.724	34.673	13.01	2625040	2480393	5/23/1998	16:51:09.11	5.874	7.714
512	46.17	18.644	0.738	34.679	13.01	2541443	2480157	5/23/1998	16:57:09.91	5.300	7.713
513	46.142	18.628	0.786	34.67	13.009	2561447	2480584	5/23/1998	17:03:10.71	5.438	7.715
514	46.117	18.595	0.8	34.676	13.009	2583691	2480850	5/23/1998	17:09:11.51	5.590	7.716
515	46.091	18.564	0.863	34.681	13.008	2580512	2481397	5/23/1998	17:15:12.31	5.569	7.718
516	46.058	18.535	0.869	34.677	13.009	2597700	2481068	5/23/1998	17:21:13.11	5.686	7.717
517	46.018	18.51	0.931	34.665	13.008	2583527	2480458	5/23/1998	17:27:13.91	5.589	7.714
518	45.997	18.473	1.007	34.679	13.006	2583268	2481198	5/23/1998	17:33:14.71	5.587	7.717
519	45.968	18.438	1.004	34.683	13.006	2568334	2481410	5/23/1998	17:39:15.51	5.485	7.718
520	45.936	18.414	1.066	34.676	13.005	2557581	2480883	5/23/1998	17:45:16.31	5.411	7.716
521	45.906	18.378	1.088	34.681	13.006	2606974	2481370	5/23/1998	17:51:17.11	5.750	7.718
522	45.878	18.346	1.107	34.684	13.005	2573104	2481574	5/23/1998	17:57:17.91	5.518	7.719
523	45.851	18.322	1.128	34.682	13.005	2594137	2480791	5/23/1998	18:03:18.71	5.662	7.716
524	45.826	18.286	1.168	34.691	13.004	2583724	2481147	5/23/1998	18:09:19.51	5.591	7.717
525	45.799	18.272	1.214	34.68	13.003	2606361	2481657	5/23/1998	18:15:20.31	5.746	7.719
526	45.78	18.25	1.263	34.683	13.003	2588500	2481590	5/23/1998	18:21:21.11	5.623	7.719
527	45.758	18.226	1.285	34.685	13.004	2527076	2480819	5/23/1998	18:27:21.91	5.202	7.716
528	45.735	18.208	1.332	34.679	13.002	2575497	2481792	5/23/1998	18:33:22.71	5.534	7.720
529	45.714	18.179	1.341	34.687	13.002	2585060	2481844	5/23/1998	18:39:23.51	5.600	7.720
530	45.682	18.147	1.357	34.686	13.002	2549996	2481082	5/23/1998	18:45:24.31	5.359	7.717
531	45.652	18.12	1.384	34.683	13.001	2572520	2481750	5/23/1998	18:51:25.11	5.514	7.720
532	45.623	18.088	1.391	34.686	13.001	2568332	2481663	5/23/1998	18:57:25.91	5.485	7.719
533	45.596	18.056	1.411	34.69	13	2578605	2482370	5/23/1998	19:03:26.71	5.555	7.723
534	45.556	18.021	1.419	34.687	12.999	2538940	2481953	5/23/1998	19:09:27.51	5.283	7.721
535	45.527	17.994	1.468	34.684	13	2541101	2481752	5/23/1998	19:15:28.31	5.298	7.720
536	45.505	17.96	1.491	34.695	12.999	2549788	2482844	5/23/1998	19:21:29.11	5.358	7.725
537	45.473	17.931	1.49	34.692	13.001	2568552	2482291	5/23/1998	19:27:29.91	5.486	7.722
538	45.445	17.905	1.48	34.689	12.998	2536868	2481457	5/23/1998	19:33:30.71	5.269	7.719
539	45.417	17.872	1.482	34.694	12.998	2562550	2482398	5/23/1998	19:39:31.51	5.445	7.723
540	45.396	17.855	1.503	34.69	12.997	2545116	2481969	5/23/1998	19:45:32.31	5.326	7.721
541	45.373	17.832	1.541	34.69	12.996	2532734	2482432	5/23/1998	19:51:33.11	5.241	7.723
542	45.349	17.813	1.501	34.686	12.995	2573317	2481901	5/23/1998	19:57:33.91	5.519	7.721
543	45.334	17.782	1.504	34.699	12.995	2503493	2482177	5/23/1998	20:03:34.71	5.040	7.722
544	45.316	17.772	1.465	34.692	12.997	2541711	2482256	5/23/1998	20:09:35.51	5.302	7.722
545	45.301	17.746	1.485	34.702	12.995	2549164	2482774	5/23/1998	20:15:36.31	5.353	7.724
546	45.288	17.734	1.472	34.701	12.995	2573047	2482208	5/23/1998	20:21:37.11	5.517	7.722
547	45.271	17.719	1.425	34.699	12.996	2545708	2482614	5/23/1998	20:27:37.91	5.330	7.724
548	45.255	17.706	1.423	34.697	12.996	2542285	2481805	5/23/1998	20:33:38.71	5.306	7.720
549	45.242	17.686	1.428	34.702	12.993	2550228	2482247	5/23/1998	20:39:39.51	5.361	7.722
550	45.23	17.673	1.414	34.703	12.995	2581937	2482300	5/23/1998	20:45:40.31	5.578	7.722
551	45.211	17.66	1.399	34.698	12.993	2570273	2481932	5/23/1998	20:51:41.11	5.498	7.721
552	45.199	17.646	1.37	34.699	12.993	2549604	2482879	5/23/1998	20:57:41.91	5.356	7.725
553	45.187	17.626	1.305	34.707	12.993	2541774	2482251	5/23/1998	21:03:42.71	5.303	7.722
554	45.176	17.619	1.312	34.704	12.992	2572604	2481994	5/23/1998	21:09:43.51	5.514	7.721
555	45.163	17.621	1.295	34.69	12.992	2533328	2483003	5/23/1998	21:15:44.31	5.245	7.725
556	45.16	17.593	1.264	34.712	12.992	2553867	2482282	5/23/1998	21:21:45.11	5.386	7.722
557	45.145	17.589	1.224	34.702	12.991	2528496	2482018	5/23/1998	21:27:45.91	5.212	7.721
558	45.143	17.577	1.18	34.711	12.991	2573246	2482777	5/23/1998	21:33:46.71	5.519	7.724
559	45.136	17.58	1.162	34.701	12.99	2543755	2482861	5/23/1998	21:39:47.51	5.316	7.725
560	45.126	17.566	1.103	34.705	12.992	2524751	2482836	5/23/1998	21:45:48.31	5.186	7.725
561	45.117	17.563	1.052	34.701	12.991	2586559	2482209	5/23/1998	21:51:49.11	5.610	7.722
562	45.115	17.561	0.987	34.701	12.99	2567427	2482785	5/23/1998	21:58:31.19	5.479	7.724
563	45.107	17.553	0.969	34.7	12.99	2506946	2483473	5/23/1998	22:04:31.99	5.064	7.727
564	45.105	17.541	0.908	34.708	12.99	2570293	2482717	5/23/1998	22:10:32.79	5.498	7.724
565	45.101	17.544	0.87	34.703	12.989	2520401	2483099	5/23/1998	22:16:33.59	5.156	7.726
566	45.1	17.542	0.835	34.703	12.989	2560565	2483233	5/23/1998	22:22:34.39	5.432	7.726
567	45.092	17.531	0.776	34.706	12.988	2564660	2482768	5/23/1998	22:28:35.19	5.460	7.724
568	45.087	17.524	0.757	34.707	12.989	2591988	2482636	5/23/1998	22:34:35.99	5.647	7.724
569	45.089	17.524	0.681	34.709	12.99	2564991	2482864	5/23/1998	22:40:36.79	5.462	7.725
570	45.08	17.525	0.635	34.701	12.989	2563840	2482469	5/23/1998	22:46:37.59	5.454	7.723
571	45.087	17.531	0.563	34.701	12.989	2557546	2482790	5/23/1998	22:52:38.39	5.411	7.724
572	45.081	17.521	0.523	34.705	12.989	2554226	2482937	5/23/1998	22:58:39.19	5.388	7.725
573	45.086	17.519	0.499	34.711	12.989	2555007	2483189	5/23/1998	23:04:39.99	5.393	7.726
574	45.086	17.513	0.412	34.716	12.988	2556514	2483846	5/23/1998	23:10:40.79	5.404	7.729
575	45.079	17.52	0.366	34.705	12.989	2543696	2483116	5/23/1998	23:16:41.59	5.316	7.726
576	45.086	17.522	0.31	34.709	12.988	2558715	2482789	5/23/1998	23:22:42.39	5.419	7.724
577	45.093	17.527	0.286	34.71	12.989	2522378	2483076	5/23/1998	23:28:43.19	5.170	7.726
578	45.101	17.534	0.256	34.711	12.988	2547002	2483104	5/23/1998	23:34:43.99	5.339	7.726
579	45.108	17.543	0.198	34.71	12.988	2523847	2482955	5/23/1998	23:40:44.79	5.180	7.725
580	45.105	17.537	0.128	34.712	12.987	2558518	2483796	5/23/1998	23:46:45.59	5.418	7.729
581	45.115	17.556	0.086	34.705	12.986	2556187	2483044	5/23/1998	23:52:46.39	5.402	7.725

Record No.	Conductivity (mS/cm)	Temperature (Deg. C)	Pressure (dBar)	Salinity (PSU)	CTD Bat. (Vdc)	D.O. (Integer)	pH (Integer)	Date	Time	D.O. (ml/L)	pH (Value)
582	45.129	17.566	0.03	34.709	12.987	2500909	2483400	5/23/1998	23:58:47.19	5.022	7.727
583	45.137	17.573	-0.008	34.709	12.987	2540087	2483205	5/24/1998	00:04:47.99	5.291	7.726
584	45.142	17.589	-0.057	34.7	12.987	2557522	2482857	5/24/1998	00:10:48.79	5.411	7.725
585	45.156	17.586	-0.112	34.715	12.988	2544295	2483388	5/24/1998	00:16:49.59	5.320	7.727
586	45.164	17.595	-0.152	34.714	12.986	2512824	2483547	5/24/1998	00:22:50.39	5.104	7.728
587	45.172	17.609	-0.208	34.709	12.986	2583169	2483441	5/24/1998	00:28:51.19	5.587	7.727
588	45.202	17.638	-0.239	34.71	12.986	2545343	2483371	5/24/1998	00:34:51.99	5.327	7.727
589	45.221	17.66	-0.313	34.707	12.986	2567448	2483139	5/24/1998	00:40:52.79	5.479	7.726
590	45.251	17.683	-0.336	34.714	12.987	2542378	2483583	5/24/1998	00:46:53.59	5.307	7.728
591	45.279	17.717	-0.372	34.708	12.988	2565647	2483039	5/24/1998	00:52:54.39	5.466	7.725
592	45.318	17.75	-0.389	34.713	12.988	2528270	2483811	5/24/1998	00:58:55.19	5.210	7.729
593	45.352	17.784	-0.422	34.714	12.989	2553815	2483501	5/24/1998	01:04:55.99	5.385	7.727
594	45.39	17.828	-0.459	34.709	12.988	2547765	2483306	5/24/1998	01:10:56.79	5.344	7.727
595	45.436	17.887	-0.478	34.698	12.988	2570320	2483246	5/24/1998	01:16:57.59	5.499	7.726
596	45.487	17.922	-0.506	34.712	12.989	2580803	2483211	5/24/1998	01:22:58.39	5.571	7.726
597	45.529	17.966	-0.523	34.71	12.99	2568912	2483041	5/24/1998	01:28:59.19	5.489	7.725
598	45.581	18.024	-0.573	34.705	12.99	2533323	2482691	5/24/1998	01:34:59.99	5.245	7.724
599	45.616	18.063	-0.605	34.702	12.99	2595121	2482810	5/24/1998	01:41:00.79	5.669	7.724
600	45.664	18.1	-0.635	34.712	12.99	2546168	2482842	5/24/1998	01:47:01.59	5.333	7.725
601	45.711	18.159	-0.648	34.702	12.991	2534781	2482967	5/24/1998	01:53:02.39	5.255	7.725
602	45.748	18.192	-0.665	34.706	12.992	2552269	2483090	5/24/1998	01:59:03.19	5.375	7.726
603	45.786	18.235	-0.701	34.701	12.99	2568990	2482724	5/24/1998	02:05:03.99	5.489	7.724
604	45.82	18.298	-0.684	34.676	12.991	2525259	2482959	5/24/1998	02:11:04.79	5.189	7.725
605	45.854	18.311	-0.714	34.694	12.991	2538785	2483365	5/24/1998	02:17:05.59	5.282	7.727
606	45.893	18.344	-0.699	34.699	12.989	2567812	2483468	5/24/1998	02:23:06.39	5.481	7.727
607	45.935	18.391	-0.725	34.695	12.99	2541899	2483093	5/24/1998	02:29:07.19	5.304	7.726
608	45.964	18.42	-0.719	34.695	12.992	2540393	2482727	5/24/1998	02:35:07.99	5.293	7.724
609	45.992	18.449	-0.739	34.695	12.991	2540277	2482763	5/24/1998	02:41:08.79	5.292	7.724
610	46.023	18.474	-0.73	34.7	12.993	2537097	2482703	5/24/1998	02:47:09.59	5.271	7.724
611	46.043	18.493	-0.754	34.701	12.992	2576601	2482464	5/24/1998	02:53:10.39	5.542	7.723
612	46.068	18.519	-0.751	34.699	12.992	2558954	2482937	5/24/1998	02:59:11.19	5.421	7.725
613	46.088	18.542	-0.737	34.697	12.991	2541793	2481986	5/24/1998	03:05:11.99	5.303	7.721
614	46.115	18.572	-0.723	34.695	12.992	2587505	2482243	5/24/1998	03:11:12.79	5.616	7.722
615	46.146	18.592	-0.715	34.704	12.993	2575389	2482031	5/24/1998	03:17:13.59	5.533	7.721
616	46.166	18.627	-0.71	34.692	12.991	2563601	2483049	5/24/1998	03:23:14.39	5.452	7.725
617	46.191	18.654	-0.686	34.689	12.991	2577697	2481794	5/24/1998	03:29:15.19	5.549	7.720
618	46.219	18.675	-0.661	34.696	12.99	2537695	2482100	5/24/1998	03:35:15.99	5.275	7.721
619	46.245	18.706	-0.645	34.692	12.992	2545402	2482519	5/24/1998	03:41:16.79	5.328	7.723
620	46.269	18.737	-0.62	34.685	12.991	2536966	2482121	5/24/1998	03:47:17.59	5.270	7.721
621	46.296	18.754	-0.594	34.694	12.99	2579232	2482448	5/24/1998	03:53:18.39	5.560	7.723
622	46.316	18.782	-0.555	34.687	12.99	2520219	2482138	5/24/1998	03:59:19.19	5.155	7.722
623	46.346	18.798	-0.519	34.699	12.991	2569504	2482001	5/24/1998	04:05:19.99	5.493	7.721
624	46.376	18.836	-0.49	34.692	12.991	2581072	2481781	5/24/1998	04:11:20.79	5.572	7.720
625	46.397	18.861	-0.465	34.688	12.991	2533552	2481614	5/24/1998	04:17:21.59	5.246	7.719
626	46.421	18.884	-0.448	34.689	12.991	2596221	2481413	5/24/1998	04:23:22.39	5.676	7.718
627	46.437	18.902	-0.44	34.687	12.991	2538500	2481251	5/24/1998	04:29:23.19	5.280	7.718
628	46.461	18.928	-0.391	34.686	12.991	2604953	2481362	5/24/1998	04:35:23.99	5.736	7.718
629	46.476	18.945	-0.366	34.685	12.991	2585740	2481356	5/24/1998	04:41:24.79	5.604	7.718
630	46.491	18.959	-0.308	34.686	12.99	2567337	2481101	5/24/1998	04:47:25.59	5.478	7.717
631	46.513	18.978	-0.275	34.687	12.99	2529637	2480978	5/24/1998	04:53:26.39	5.219	7.717
632	46.526	18.992	-0.233	34.687	12.99	2543221	2480621	5/24/1998	05:00:08.47	5.313	7.715
633	46.538	19.008	-0.19	34.684	12.989	2592995	2480589	5/24/1998	05:06:09.27	5.654	7.715
634	46.553	19.021	-0.14	34.686	12.992	2569245	2481033	5/24/1998	05:12:10.07	5.491	7.717
635	46.562	19.033	-0.097	34.683	12.989	2547902	2480931	5/24/1998	05:18:10.87	5.345	7.716
636	46.567	19.04	-0.081	34.68	12.99	2574859	2481231	5/24/1998	05:24:11.67	5.530	7.718
637	46.572	19.043	-0.044	34.683	12.989	2567125	2480746	5/24/1998	05:30:12.47	5.477	7.716
638	46.561	19.035	0	34.679	12.99	2540199	2480925	5/24/1998	05:36:13.27	5.292	7.716
639	46.555	19.02	0.045	34.687	12.989	2593297	2481167	5/24/1998	05:42:14.07	5.656	7.717
640	46.537	19.019	0.046	34.673	12.989	2541115	2481025	5/24/1998	05:48:14.87	5.298	7.717
641	46.535	18.995	0.088	34.692	12.99	2588694	2480306	5/24/1998	05:54:15.67	5.625	7.714
642	46.519	18.987	0.133	34.685	12.989	2581442	2480319	5/24/1998	06:00:16.47	5.575	7.714
643	46.495	18.971	0.179	34.679	12.988	2556843	2480428	5/24/1998	06:06:17.27	5.406	7.714
644	46.484	18.949	0.202	34.687	12.99	2623828	2480374	5/24/1998	06:12:18.07	5.866	7.714
645	46.463	18.928	0.247	34.687	12.988	2553731	2480736	5/24/1998	06:18:18.87	5.385	7.715
646	46.444	18.913	0.293	34.684	12.988	2598748	2480040	5/24/1998	06:24:19.67	5.694	7.712
647	46.422	18.889	0.331	34.686	12.989	2534929	2480518	5/24/1998	06:30:20.47	5.256	7.715
648	46.393	18.863	0.384	34.684	12.986	2568590	2480127	5/24/1998	06:36:21.27	5.487	7.713
649	46.37	18.836	0.396	34.686	12.984	2591569	2480807	5/24/1998	06:42:22.07	5.644	7.716
650	46.35	18.811	0.414	34.69	12.985	2518750	2480723	5/24/1998	06:48:22.87	5.145	7.715
651	46.326	18.788	0.445	34.69	12.986	2569182	2480286	5/24/1998	06:54:23.67	5.491	7.714
652	46.296	18.758	0.497	34.69	12.984	2589712	2479956	5/24/1998	07:00:24.47	5.632	7.712
653	46.264	18.727	0.528	34.69	12.985	2615226	2480044	5/24/1998	07:06:25.27	5.807	7.712
654	46.236	18.698	0.531	34.69	12.982	2577135	2481169	5/24/1998	07:12:26.07	5.545	7.717
655	46.212	18.67	0.545	34.693	12.982	2546537	2479903	5/24/1998	07:18:26.87	5.335	7.712
656	46.189	18.648	0.578	34.692	12.982	2577851	2479914	5/24/1998	07:24:27.67	5.550	7.712
657	46.163	18.623	0.64	34.692	12.981	2569404	2480390	5/24/1998	07:30:28.47	5.492	7.714
658	46.138	18.582	0.691	34.705	12.981	2548668	2479683	5/24/1998	07:36:29.27	5.350	7.711
659	46.114	18.568	0.676	34.696	12.981	2599476	2480805	5/24/1998	07:42:30.07	5.699	7.716
660	46.093	18.556	0.68	34.689	12.98	2584971	2480287	5/24/1998	07:48:30.87	5.599	7.714
661	46.075	18.535	0.735	34.692	12.981	2552176	2481159	5/24/1998	07:54:31.67	5.374	7.717
662	46.057	18.508	0.76	34.699	12.98	2577478	2479673	5/24/1998	08:00:32.47	5.548	7.711
663	46.037	18.492	0.73	34.696	12.981	2512271	2480312	5/24/1998	08:06:33.27	5.100	7.714
664	46.016	18.475	0.759	34.692	12.979	2561416	2480509	5/24/1998	08:12:34.07	5.437	7.714
665	45.983	18.437	0.784	34.696	12.978	2587310	2479662	5/24/1998	08:18:34.87	5.615	7.711
666	45.957	18.41	0.804	34.697	12.979	2524612	2480053	5/24/1998	08:24:35.67	5.185	7.713
667	45.93	18.384	0.833	34.697	12.977	2547238	2480214	5/24/1998	08:30:36.47	5.340	7.713
668	45.898	18.349	0.809	34.7	12.978	2509149	2479837	5/24/1998	08:36:37.27	5.079	7.712
669	45.873	18.317	0.808	34.704	12.977	2499807	2480035	5/24/1998	08:42:38.07	5.015	7.712
670	45.848	18.295	0.817	34.702	12.978	2586391	2479196	5/24/1998	08:48:38.87	5.609	7.709
671	45.813	18.271	0.821	34.693	12.976	2545989	2479758	5/24/1998	08:54:39.67	5.332	7.711
672	45.801	18.252	0.798	34.699	12.976	2531883	2479912	5/24/1998	09:00:40.47	5.235	7.712
673	45.774	18.224	0.81	34.7	12.975	2552643	2479717	5/24/1998	09:06:41.27	5.377	7.711
674	45.759	18.21	0.843	34.698	12.975	2570936	2479692	5/24/1998	09:12:42.07	5.503	7.711
675	45.744	18.187	0.814	34.706	12.977	2548121	2479790	5/24/1998	09:18:42.87	5.346	7.711

Record No.	Conductivity (mS/cm)	Temperature (Deg. C)	Pressure (dBar)	Salinity (PSU)	CTD Bat. (Vdc)	D.O. (Integer)	pH (Integer)	Date	Time	D.O. (ml/L)	pH (Value)
676	45.736	18.176	0.823	34.708	12.975	2528995	2479496	5/24/1998	09:24:43.67	5.215	7.710
677	45.718	18.159	0.81	34.707	12.974	2532611	2480202	5/24/1998	09:30:44.47	5.240	7.713
678	45.708	18.152	0.753	34.704	12.975	2540490	2479465	5/24/1998	09:36:45.27	5.294	7.710
679	45.696	18.149	0.708	34.697	12.974	2560060	2479524	5/24/1998	09:42:46.07	5.428	7.710
680	45.692	18.132	0.723	34.708	12.973	2560181	2480266	5/24/1998	09:48:46.87	5.429	7.713
681	45.68	18.116	0.698	34.711	12.974	2537599	2479712	5/24/1998	09:54:47.67	5.274	7.711
682	45.663	18.103	0.657	34.708	12.972	2538305	2479775	5/24/1998	10:00:48.47	5.279	7.711
683	45.65	18.086	0.651	34.711	12.972	2526122	2480495	5/24/1998	10:06:49.27	5.195	7.714
684	45.634	18.066	0.649	34.715	12.971	2537052	2480465	5/24/1998	10:12:50.07	5.270	7.714
685	45.621	18.07	0.662	34.7	12.971	2571463	2480276	5/24/1998	10:18:50.87	5.506	7.713
686	45.609	18.046	0.567	34.71	12.97	2570091	2479485	5/24/1998	10:24:51.67	5.497	7.710
687	45.594	18.032	0.55	34.709	12.97	2576956	2480144	5/24/1998	10:30:52.47	5.544	7.713
688	45.585	18.024	0.512	34.708	12.97	2549565	2479847	5/24/1998	10:36:53.27	5.356	7.712
689	45.581	18.02	0.509	34.709	12.969	2540772	2480086	5/24/1998	10:42:54.07	5.296	7.713
690	45.574	18.019	0.486	34.704	12.97	2560019	2479711	5/24/1998	10:48:54.87	5.428	7.711
691	45.568	18.008	0.424	34.708	12.968	2561840	2479781	5/24/1998	10:54:55.67	5.440	7.711
692	45.559	17.995	0.402	34.711	12.968	2553935	2479301	5/24/1998	11:00:56.47	5.386	7.709
693	45.553	17.997	0.371	34.704	12.966	2555828	2479552	5/24/1998	11:06:57.27	5.399	7.710
694	45.554	17.994	0.331	34.708	12.968	2525852	2479064	5/24/1998	11:12:58.07	5.193	7.708
695	45.542	17.984	0.284	34.706	12.969	2558633	2479656	5/24/1998	11:18:58.87	5.418	7.711
696	45.546	17.99	0.252	34.704	12.969	2534397	2478554	5/24/1998	11:24:59.67	5.252	7.706
697	45.534	17.988	0.244	34.696	12.969	2550951	2479299	5/24/1998	11:31:00.47	5.366	7.709
698	45.538	17.981	0.211	34.705	12.97	2564371	2478272	5/24/1998	11:37:01.27	5.458	7.705
699	45.552	17.989	0.191	34.71	12.969	2540574	2479039	5/24/1998	11:43:02.07	5.294	7.708
700	45.557	17.999	0.135	34.706	12.968	2549046	2479188	5/24/1998	11:49:02.87	5.353	7.709
701	45.573	18.008	0.124	34.711	12.969	2521176	2478542	5/24/1998	11:55:03.67	5.161	7.706

Blank Test #3 Sensor Data

Record No.	Conductivity (mS/cm)	Temperature (Deg. C)	Pressure (dBar)	Salinity (PSU)	CTD Bat. (Vdc)	D.O. (Integer)	pH (Integer)	Date	Time	D.O. (ml/L)	pH (Value)
1	45.815	18.716	1.364	34.32	13.006	2290723	2452020	5/28/1998	09:28:05.56	3.580	7.591
2	45.925	18.688	1.382	34.436	13.015	2223053	2462045	5/28/1998	09:34:47.56	3.115	7.635
3	45.99	18.683	1.404	34.495	12.967	2293106	2465218	5/28/1998	09:40:48.37	3.596	7.648
4	46.056	18.669	1.456	34.563	13.001	2236476	2466725	5/28/1998	09:46:49.16	3.207	7.655
5	46.083	18.653	1.469	34.598	13.01	2238362	2467832	5/28/1998	09:52:49.96	3.220	7.660
6	46.096	18.634	1.486	34.626	13.016	2245414	2469430	5/28/1998	09:58:50.76	3.269	7.667
7	46.113	18.621	1.497	34.651	13.017	2206619	2469853	5/28/1998	10:04:51.56	3.002	7.668
8	46.12	18.609	1.537	34.667	13.02	2186797	2470326	5/28/1998	10:10:52.36	2.866	7.670
9	46.109	18.59	1.566	34.673	13.019	2213549	2470326	5/28/1998	10:16:53.16	3.050	7.670
10	46.093	18.569	1.616	34.678	13.02	2222627	2472133	5/28/1998	10:22:53.96	3.112	7.678
11	46.071	18.52	1.666	34.7	13.019	2158621	2472106	5/28/1998	10:28:54.76	2.673	7.678
12	46.028	18.485	1.627	34.694	13.018	2229338	2472252	5/28/1998	10:34:55.56	3.158	7.679
13	45.974	18.431	1.63	34.694	13.017	2273754	2472350	5/28/1998	10:40:56.36	3.463	7.679
14	45.909	18.363	1.691	34.696	13.016	2257372	2473658	5/28/1998	10:46:57.16	3.351	7.685
15	45.844	18.287	1.698	34.706	13.014	2232544	2473818	5/28/1998	10:52:57.96	3.180	7.686
16	45.787	18.235	1.734	34.702	13.014	2205787	2474933	5/28/1998	10:58:58.76	2.997	7.690
17	45.729	18.165	1.798	34.711	13.013	2207467	2474394	5/28/1998	11:04:59.56	3.008	7.688
18	45.668	18.097	1.792	34.717	13.011	2206701	2474872	5/28/1998	11:11:00.36	3.003	7.690
19	45.612	18.033	1.824	34.723	13.01	2154618	2474108	5/28/1998	11:17:01.16	2.646	7.687
20	45.552	17.966	1.816	34.729	13.008	2156546	2474537	5/28/1998	11:23:01.96	2.659	7.689
21	45.485	17.906	1.871	34.723	13.007	2302887	2474953	5/28/1998	11:29:02.76	3.663	7.690
22	45.426	17.855	1.867	34.716	13.007	2175133	2474923	5/28/1998	11:35:03.56	2.786	7.690
23	45.397	17.813	1.852	34.727	13.005	2151673	2475793	5/28/1998	11:41:04.36	2.625	7.694
24	45.341	17.76	1.816	34.724	13.005	2195048	2475315	5/28/1998	11:47:05.16	2.923	7.692
25	45.287	17.701	1.878	34.728	13.003	2170562	2475311	5/28/1998	11:53:05.96	2.755	7.692
26	45.254	17.669	1.904	34.727	13.002	2224754	2475966	5/28/1998	11:59:06.76	3.127	7.695
27	45.225	17.63	1.949	34.735	13.002	2236781	2476073	5/28/1998	12:05:07.56	3.209	7.695
28	45.188	17.592	1.943	34.736	13.001	2171152	2476342	5/28/1998	12:11:08.36	2.759	7.696
29	45.153	17.555	1.931	34.738	12.999	2205415	2476254	5/28/1998	12:17:09.16	2.994	7.696
30	45.123	17.529	1.964	34.734	12.999	2192285	2476613	5/28/1998	12:23:09.96	2.904	7.698
31	45.088	17.492	1.883	34.736	12.998	2176514	2476551	5/28/1998	12:29:10.76	2.796	7.697
32	45.061	17.464	1.939	34.736	12.998	2197530	2476934	5/28/1998	12:35:11.56	2.940	7.699
33	45.022	17.429	1.936	34.733	12.997	2210250	2477219	5/28/1998	12:41:12.36	3.027	7.700
34	44.997	17.399	1.902	34.737	12.997	2167761	2477830	5/28/1998	12:47:13.16	2.736	7.703
35	44.97	17.373	1.927	34.736	12.994	2240925	2477797	5/28/1998	12:53:13.96	3.238	7.703
36	44.932	17.331	1.882	34.739	12.994	2208959	2476901	5/28/1998	12:59:14.76	3.019	7.699
37	44.902	17.294	1.879	34.745	12.994	2183254	2477105	5/28/1998	13:05:15.56	2.842	7.700
38	44.863	17.275	1.85	34.728	12.991	2211296	2477412	5/28/1998	13:11:16.36	3.035	7.701
39	44.834	17.225	1.855	34.745	12.991	2191683	2477101	5/28/1998	13:17:17.16	2.900	7.700
40	44.786	17.171	1.821	34.75	12.99	2185387	2478957	5/28/1998	13:23:17.96	2.857	7.708
41	44.744	17.134	1.823	34.745	12.989	2270538	2478453	5/28/1998	13:29:18.76	3.441	7.706
42	44.717	17.112	1.785	34.741	12.989	2226386	2477935	5/28/1998	13:35:19.56	3.138	7.703
43	44.697	17.081	1.784	34.75	12.987	2287064	2478254	5/28/1998	13:41:20.36	3.555	7.705
44	44.679	17.066	1.803	34.747	12.99	2167817	2478587	5/28/1998	13:47:21.16	2.736	7.706
45	44.663	17.048	1.768	34.75	12.987	2231016	2478824	5/28/1998	13:53:21.96	3.170	7.707
46	44.658	17.034	1.769	34.756	12.987	2184851	2478275	5/28/1998	13:59:22.76	2.853	7.705
47	44.635	17.02	1.706	34.749	12.986	2225184	2478505	5/28/1998	14:05:23.56	3.130	7.706
48	44.616	16.991	1.698	34.758	12.985	2280386	2479179	5/28/1998	14:11:24.36	3.509	7.709
49	44.596	16.98	1.716	34.75	12.984	2169856	2478613	5/28/1998	14:17:25.16	2.750	7.706
50	44.576	16.963	1.652	34.747	12.984	2181731	2480505	5/28/1998	14:23:25.96	2.832	7.714
51	44.558	16.937	1.638	34.754	12.985	2296427	2478729	5/28/1998	14:29:26.76	3.619	7.707
52	44.535	16.933	1.61	34.738	12.983	2169892	2478429	5/28/1998	14:35:27.56	2.750	7.706
53	44.531	16.923	1.6	34.742	12.983	2253349	2479582	5/28/1998	14:41:28.36	3.323	7.710
54	44.533	16.918	1.581	34.748	12.982	2256639	2479462	5/28/1998	14:47:29.16	3.346	7.710
55	44.528	16.908	1.557	34.753	12.981	2226991	2480557	5/28/1998	14:53:29.96	3.142	7.715
56	44.518	16.899	1.571	34.752	12.983	2241897	2480650	5/28/1998	14:59:30.76	3.245	7.715
57	44.527	16.915	1.504	34.745	12.958	2316993	2480476	5/28/1998	15:05:31.56	3.760	7.714
58	44.549	16.925	1.489	34.756	12.969	2308439	2480391	5/28/1998	15:11:32.36	3.701	7.714
59	44.571	16.949	1.482	34.754	12.974	2298706	2479076	5/28/1998	15:17:33.16	3.634	7.708
60	44.584	16.968	1.454	34.75	12.975	2188520	2480158	5/28/1998	15:23:33.96	2.878	7.713
61	44.611	16.993	1.49	34.751	12.976	2281052	2480822	5/28/1998	15:29:34.76	3.513	7.716

Record No.	Conductivity (mS/cm)	Temperature (Deg. C)	Pressure (dBar)	Salinity (PSU)	CTD Bat. (Vdc)	D.O. (Integer)	pH (Integer)	Date	Time	D.O. (ml/L)	pH (Value)
62	44.652	17.032	1.461	34.753	12.977	2232378	2480235	5/28/1998	15:35:35.56	3.179	7.713
63	44.698	17.07	1.431	34.76	12.977	2227837	2481468	5/28/1998	15:41:36.36	3.148	7.719
64	44.732	17.124	1.423	34.744	12.978	2310947	2481383	5/28/1998	15:47:37.16	3.718	7.718
65	44.76	17.135	1.393	34.759	12.978	2269562	2481657	5/28/1998	15:53:37.96	3.434	7.719
66	44.793	17.184	1.387	34.745	12.978	2142602	2481480	5/28/1998	15:59:38.76	2.563	7.719
67	44.836	17.218	1.397	34.753	12.978	2359776	2481416	5/28/1998	16:05:39.56	4.054	7.718
68	44.885	17.26	1.37	34.759	12.978	2187769	2481843	5/28/1998	16:11:40.36	2.873	7.720
69	44.938	17.327	1.325	34.748	12.98	2264049	2481391	5/28/1998	16:17:41.16	3.397	7.718
70	44.979	17.371	1.32	34.745	12.98	2257395	2483061	5/28/1998	16:23:41.96	3.351	7.726
71	45.027	17.412	1.361	34.752	12.979	2255995	2483105	5/28/1998	16:29:42.76	3.341	7.726
72	45.075	17.466	1.344	34.747	12.978	2179090	2482225	5/28/1998	16:36:24.77	2.814	7.722
73	45.12	17.505	1.357	34.752	12.979	2306360	2482959	5/28/1998	16:42:25.57	3.687	7.725
74	45.163	17.553	1.318	34.748	12.98	2216848	2482842	5/28/1998	16:48:26.37	3.073	7.725
75	45.206	17.602	1.312	34.743	12.982	2299811	2483179	5/28/1998	16:54:27.17	3.642	7.726
76	45.248	17.647	1.346	34.741	12.978	2347777	2482750	5/28/1998	17:00:27.97	3.971	7.724
77	45.294	17.686	1.295	34.747	12.979	2270299	2483758	5/28/1998	17:06:28.77	3.440	7.729
78	45.341	17.736	1.28	34.745	12.979	2326224	2483566	5/28/1998	17:12:29.57	3.823	7.728
79	45.379	17.773	1.276	34.746	12.978	2330116	2483555	5/28/1998	17:18:30.37	3.850	7.728
80	45.411	17.809	1.258	34.743	12.979	2194439	2484385	5/28/1998	17:24:31.17	2.919	7.731
81	45.44	17.832	1.294	34.748	12.977	2257972	2484310	5/28/1998	17:30:31.97	3.355	7.731
82	45.455	17.862	1.269	34.735	12.979	2273135	2484298	5/28/1998	17:36:32.77	3.459	7.731
83	45.47	17.867	1.276	34.744	12.977	2226056	2484261	5/28/1998	17:42:33.57	3.136	7.731
84	45.503	17.894	1.251	34.749	12.976	2264866	2484409	5/28/1998	17:48:34.37	3.402	7.731
85	45.524	17.918	1.303	34.746	12.974	2191887	2485034	5/28/1998	17:54:35.17	2.901	7.734
86	45.537	17.94	1.311	34.739	12.975	2206129	2484422	5/28/1998	18:00:35.97	2.999	7.731
87	45.551	17.949	1.279	34.743	12.974	2305341	2484806	5/28/1998	18:06:36.77	3.680	7.733
88	45.57	17.957	1.311	34.752	12.975	2331995	2485314	5/28/1998	18:12:37.57	3.863	7.735
89	45.578	17.982	1.308	34.738	12.976	2260783	2485226	5/28/1998	18:18:38.37	3.374	7.735
90	45.588	17.987	1.31	34.742	12.975	2344333	2485342	5/28/1998	18:24:39.17	3.948	7.735
91	45.599	17.997	1.345	34.743	12.975	2346424	2485206	5/28/1998	18:30:39.97	3.962	7.735
92	45.597	17.996	1.348	34.742	12.973	2196651	2485632	5/28/1998	18:36:40.77	2.934	7.737
93	45.598	17.996	1.324	34.744	12.972	2296295	2485061	5/28/1998	18:42:41.57	3.618	7.734
94	45.607	18.002	1.336	34.746	12.972	2319592	2485361	5/28/1998	18:48:42.37	3.778	7.735
95	45.613	17.996	1.325	34.756	12.97	2243620	2486595	5/28/1998	18:54:43.17	3.256	7.741
96	45.604	18	1.376	34.745	12.968	2275180	2486285	5/28/1998	19:00:43.97	3.473	7.739
97	45.592	17.994	1.381	34.74	12.969	2370584	2486850	5/28/1998	19:06:44.77	4.128	7.742
98	45.579	17.97	1.459	34.749	12.967	2337242	2487006	5/28/1998	19:12:45.57	3.899	7.743
99	45.571	17.962	1.459	34.749	12.969	2324875	2486095	5/28/1998	19:18:46.37	3.814	7.739
100	45.549	17.947	1.538	34.743	12.969	2238043	2486748	5/28/1998	19:24:47.17	3.218	7.741
101	45.53	17.929	1.519	34.742	12.962	2223320	2486805	5/28/1998	19:30:47.97	3.117	7.742
102	45.515	17.902	1.518	34.752	12.962	2278924	2486859	5/28/1998	19:36:48.77	3.499	7.742
103	45.5	17.888	1.515	34.751	12.964	2348339	2487286	5/28/1998	19:42:49.57	3.975	7.744
104	45.489	17.873	1.542	34.755	12.966	2312372	2487225	5/28/1998	19:48:50.37	3.728	7.744
105	45.478	17.865	1.587	34.752	12.967	2254922	2486864	5/28/1998	19:54:51.17	3.334	7.742
106	45.448	17.844	1.594	34.745	12.966	2314330	2486693	5/28/1998	20:00:51.97	3.742	7.741
107	45.425	17.817	1.618	34.748	12.967	2387819	2487259	5/28/1998	20:06:52.77	4.246	7.744
108	45.403	17.792	1.62	34.75	12.966	2296862	2486566	5/28/1998	20:12:53.57	3.622	7.741
109	45.37	17.763	1.68	34.747	12.965	2339111	2486866	5/28/1998	20:18:54.37	3.912	7.742
110	45.341	17.729	1.736	34.751	12.966	2329803	2486786	5/28/1998	20:24:55.17	3.848	7.742
111	45.294	17.679	1.705	34.753	12.964	2358646	2487401	5/28/1998	20:30:55.97	4.046	7.744
112	45.264	17.654	1.731	34.748	12.965	2330498	2487117	5/28/1998	20:36:56.77	3.853	7.743
113	45.214	17.594	1.786	34.757	12.963	2314874	2487420	5/28/1998	20:42:57.57	3.745	7.744
114	45.168	17.555	1.775	34.751	12.962	2308275	2487907	5/28/1998	20:48:58.37	3.700	7.746
115	45.116	17.505	1.811	34.748	12.962	2344272	2487680	5/28/1998	20:54:59.17	3.947	7.745
116	45.073	17.457	1.837	34.753	12.961	2317267	2487876	5/28/1998	21:00:59.97	3.762	7.746
117	45.029	17.413	1.858	34.752	12.963	2300178	2487405	5/28/1998	21:07:00.77	3.645	7.744
118	44.99	17.358	1.924	34.766	12.96	2331624	2488023	5/28/1998	21:13:01.57	3.860	7.747
119	44.958	17.33	1.878	34.762	12.96	2329359	2487137	5/28/1998	21:19:02.37	3.845	7.743
120	44.915	17.294	1.953	34.757	12.959	2262493	2488073	5/28/1998	21:25:03.17	3.386	7.747
121	44.881	17.258	1.938	34.757	12.959	2240792	2488232	5/28/1998	21:31:03.97	3.237	7.748
122	44.846	17.223	1.958	34.757	12.958	2298574	2488113	5/28/1998	21:37:04.77	3.634	7.747
123	44.809	17.183	1.98	34.76	12.957	2262848	2488095	5/28/1998	21:43:05.57	3.388	7.747
124	44.778	17.139	1.945	34.771	12.957	2331855	2487752	5/28/1998	21:49:06.37	3.862	7.746
125	44.744	17.119	2.03	34.758	12.956	2280193	2488258	5/28/1998	21:55:07.17	3.507	7.748
126	44.708	17.078	2.065	34.762	12.955	2294880	2487701	5/28/1998	22:01:07.97	3.608	7.746
127	44.681	17.045	2.079	34.768	12.955	2308214	2488757	5/28/1998	22:07:08.77	3.700	7.750
128	44.664	17.005	2.063	34.787	12.955	2315095	2487847	5/28/1998	22:13:09.57	3.747	7.746
129	44.651	17.013	2.068	34.769	12.955	2289608	2487275	5/28/1998	22:19:10.37	3.572	7.744
130	44.617	16.977	2.087	34.771	12.953	2297307	2488295	5/28/1998	22:25:11.17	3.625	7.748
131	44.597	16.964	2.123	34.764	12.952	2336293	2487711	5/28/1998	22:31:11.97	3.892	7.746
132	44.581	16.941	2.11	34.77	12.953	2304030	2487121	5/28/1998	22:37:12.77	3.671	7.743
133	44.558	16.922	2.155	34.767	12.951	2351956	2487332	5/28/1998	22:43:13.57	4.000	7.744
134	44.525	16.881	2.177	34.773	12.951	2328506	2488363	5/28/1998	22:49:14.37	3.839	7.748
135	44.519	16.867	2.184	34.78	12.952	2332990	2488786	5/28/1998	22:55:15.17	3.870	7.750
136	44.51	16.869	2.167	34.771	12.95	2325469	2487748	5/28/1998	23:01:15.97	3.818	7.746
137	44.492	16.837	2.093	34.782	12.95	2257370	2488290	5/28/1998	23:07:16.77	3.351	7.748
138	44.472	16.82	2.202	34.779	12.95	2319133	2487317	5/28/1998	23:13:17.57	3.775	7.744
139	44.455	16.818	2.154	34.766	12.951	2305456	2488250	5/28/1998	23:19:18.37	3.681	7.748
140	44.432	16.787	2.194	34.773	12.949	2309781	2487183	5/28/1998	23:25:19.17	3.710	7.743
141	44.415	16.776	2.247	34.768	12.949	2319015	2487101	5/28/1998	23:31:19.97	3.774	7.743
142	44.394	16.751	2.193	34.771	12.948	2289664	2487559	5/28/1998	23:38:01.99	3.572	7.745
143	44.37	16.717	2.19	34.78	12.948	2263307	2487832	5/28/1998	23:44:02.79	3.392	7.746
144	44.351	16.709	2.147	34.77	12.946	2311462	2487816	5/28/1998	23:50:03.59	3.722	7.746
145	44.331	16.673	2.127	34.783	12.947	2320541	2487357	5/28/1998	23:56:04.39	3.784	7.744
146	44.306	16.65	2.17	34.781	12.946	2294127	2487148	5/29/1998	00:02:05.19	3.603	7.743
147	44.273	16.621	2.141	34.778	12.947	2332644	2487030	5/29/1998	00:08:05.99	3.867	7.743
148	44.254	16.6	2.127	34.779	12.945	2323867	2487469	5/29/1998	00:14:06.79	3.807	7.745
149	44.211	16.558	2.099	34.778	12.944	2300681	2487058	5/29/1998	00:20:07.59	3.648	7.743
150	44.188	16.526	2.067	34.786	12.943	2278551	2487306	5/29/1998	00:26:08.39	3.496	7.744
151	44.165	16.503	2.034	34.786	12.942	2287298	2487392	5/29/1998	00:32:09.19	3.556	7.744
152	44.135	16.469	2.06	34.789	12.941	2331387	2487051	5/29/1998	00:38:09.99	3.859	7.743
153	44.105	16.452	2.018	34.777	12.942	2295985	2487200	5/29/1998	00:44:10.79	3.616	7.743
154	44.088	16.426	1.986	34.784	12.942	2316765	2487424	5/29/1998	00:50:11.59	3.758	7.744
155	44.081	16.409	1.998	34.793	12.939	2304255	287212	5/29/1998	00:56:12.39	3.673	7.743

Record No.	Conductivity (mS/cm)	Temperature (Deg. C)	Pressure (dBar)	Salinity (PSU)	CTD Bat. (Vdc)	D.O. (Integer)	pH (Integer)	Date	Time	D.O. (ml/L)	pH (Value)
156	44.068	16.398	1.903	34.791	12.94	2228353	2487888	5/29/1998	01:02:13.19	3.152	7.746
157	44.057	16.389	1.925	34.789	12.94	2314425	2487251	5/29/1998	01:08:13.99	3.742	7.744
158	44.051	16.381	1.876	34.791	12.939	2319702	2488199	5/29/1998	01:14:14.79	3.779	7.748
159	44.046	16.384	1.839	34.784	12.939	2336415	2487387	5/29/1998	01:20:15.59	3.893	7.744
160	44.045	16.383	1.79	34.785	12.938	2317515	2488181	5/29/1998	01:26:16.39	3.764	7.748
161	44.045	16.382	1.783	34.785	12.938	2298769	2487598	5/29/1998	01:32:17.19	3.635	7.745
162	44.051	16.378	1.777	34.793	12.94	2317622	2487845	5/29/1998	01:38:17.99	3.764	7.746
163	44.061	16.385	1.689	34.797	12.938	2309962	2488155	5/29/1998	01:44:18.79	3.712	7.748
164	44.069	16.401	1.641	34.79	12.938	2313037	2488007	5/29/1998	01:50:19.59	3.733	7.747
165	44.086	16.425	1.592	34.784	12.938	2291199	2487798	5/29/1998	01:56:20.39	3.583	7.746
166	44.099	16.429	1.587	34.792	12.937	2301553	2489464	5/29/1998	02:02:21.19	3.654	7.753
167	44.117	16.453	1.537	34.787	12.938	2285801	2488157	5/29/1998	02:08:21.99	3.546	7.748
168	44.137	16.47	1.532	34.79	12.938	2299845	2488837	5/29/1998	02:14:22.79	3.642	7.750
169	44.161	16.497	1.441	34.787	12.938	2330472	2488705	5/29/1998	02:20:23.59	3.852	7.750
170	44.189	16.521	1.404	34.79	12.938	2291325	2489317	5/29/1998	02:26:24.39	3.584	7.753
171	44.205	16.544	1.414	34.786	12.938	2313383	2488472	5/29/1998	02:32:25.19	3.735	7.749
172	44.224	16.561	1.335	34.787	12.938	2284055	2488580	5/29/1998	02:38:25.99	3.534	7.749
173	44.246	16.582	1.343	34.788	12.936	2302788	2489789	5/29/1998	02:44:26.79	3.662	7.755
174	44.261	16.599	1.257	34.787	12.937	2234953	2489218	5/29/1998	02:50:27.59	3.197	7.752
175	44.269	16.613	1.192	34.782	12.935	2320161	2489082	5/29/1998	02:56:28.39	3.782	7.752
176	44.285	16.618	1.218	34.791	12.937	2297834	2489306	5/29/1998	03:02:29.19	3.628	7.752
177	44.293	16.635	1.162	34.783	12.937	2314185	2489379	5/29/1998	03:08:29.99	3.741	7.753
178	44.305	16.64	1.103	34.789	12.935	2282847	2488953	5/29/1998	03:14:30.79	3.526	7.751
179	44.317	16.659	1.051	34.784	12.935	2313239	2489215	5/29/1998	03:20:31.59	3.734	7.752
180	44.334	16.658	1.045	34.8	12.934	2327753	2489356	5/29/1998	03:26:32.39	3.834	7.753
181	44.342	16.681	0.969	34.787	12.934	2323343	2488751	5/29/1998	03:32:33.19	3.804	7.750
182	44.372	16.713	0.928	34.785	12.937	2273363	2488426	5/29/1998	03:38:33.99	3.461	7.749
183	44.413	16.751	0.857	34.788	12.935	2298671	2489384	5/29/1998	03:44:34.79	3.634	7.753
184	44.451	16.797	0.837	34.782	12.936	2283134	2488974	5/29/1998	03:50:35.59	3.528	7.751
185	44.487	16.83	0.795	34.784	12.935	2299437	2488495	5/29/1998	03:56:36.39	3.639	7.749
186	44.516	16.855	0.766	34.788	12.935	2318111	2488873	5/29/1998	04:02:37.19	3.768	7.751
187	44.561	16.898	0.719	34.79	12.936	2285798	2489263	5/29/1998	04:08:37.99	3.546	7.752
188	44.604	16.947	0.684	34.785	12.935	2304356	2488959	5/29/1998	04:14:38.79	3.673	7.751
189	44.624	16.97	0.622	34.782	12.937	2333743	2488811	5/29/1998	04:20:39.59	3.875	7.750
190	44.646	16.999	0.599	34.778	12.935	2327689	2488726	5/29/1998	04:26:40.39	3.833	7.750
191	44.689	17.023	0.563	34.794	12.935	2326769	2489019	5/29/1998	04:32:41.19	3.827	7.751
192	44.735	17.089	0.538	34.777	12.936	2280251	2489107	5/29/1998	04:38:41.99	3.508	7.752
193	44.778	17.119	0.527	34.789	12.935	2288164	2488836	5/29/1998	04:44:42.79	3.562	7.750
194	44.815	17.162	0.453	34.784	12.936	2354815	2489096	5/29/1998	04:50:43.59	4.020	7.752
195	44.858	17.201	0.432	34.787	12.936	2327043	2489481	5/29/1998	04:56:44.39	3.829	7.753
196	44.901	17.252	0.405	34.78	12.937	2193583	2488516	5/29/1998	05:02:45.19	2.913	7.749
197	44.955	17.308	0.372	34.779	12.936	2283462	2489276	5/29/1998	05:08:45.99	3.530	7.752
198	44.983	17.337	0.347	34.779	12.936	2331071	2488929	5/29/1998	05:14:46.79	3.857	7.751
199	44.983	17.351	0.316	34.767	12.934	2326903	2488973	5/29/1998	05:20:47.59	3.828	7.751
200	45.026	17.391	0.317	34.769	12.935	2299905	2488970	5/29/1998	05:26:48.39	3.643	7.751
201	45.074	17.43	0.274	34.777	12.935	2297999	2489074	5/29/1998	05:32:49.19	3.630	7.751
202	45.111	17.468	0.274	34.777	12.936	2331391	2488920	5/29/1998	05:38:49.99	3.859	7.751
203	45.156	17.504	0.201	34.785	12.937	2296867	2489300	5/29/1998	05:44:50.79	3.622	7.752
204	45.195	17.561	0.209	34.769	12.939	2321373	2488326	5/29/1998	05:50:51.59	3.790	7.748
205	45.243	17.598	0.216	34.779	12.937	2322803	2488669	5/29/1998	05:56:52.39	3.800	7.750
206	45.28	17.64	0.201	34.775	12.938	2344243	2489041	5/29/1998	06:02:53.19	3.947	7.751
207	45.321	17.679	0.156	34.776	12.936	2378781	2487804	5/29/1998	06:08:53.99	4.184	7.746
208	45.348	17.705	0.179	34.778	12.938	2366713	2488640	5/29/1998	06:14:54.79	4.101	7.750
209	45.388	17.747	0.172	34.776	12.936	2334393	2488707	5/29/1998	06:20:55.59	3.879	7.750
210	45.422	17.791	0.159	34.767	12.937	2255886	2487790	5/29/1998	06:26:56.39	3.341	7.746
211	45.462	17.83	0.169	34.769	12.94	2349147	2487964	5/29/1998	06:32:57.19	3.981	7.747
212	45.51	17.866	0.145	34.779	12.937	2347306	2488192	5/29/1998	06:39:39.22	3.968	7.748
213	45.538	17.905	0.138	34.77	12.936	2291856	2487561	5/29/1998	06:45:40.02	3.587	7.745
214	45.576	17.945	0.143	34.768	12.936	2222965	2487628	5/29/1998	06:51:40.82	3.115	7.745
215	45.616	17.983	0.17	34.77	12.94	2330958	2487773	5/29/1998	06:57:41.62	3.856	7.746
216	45.654	18.03	0.152	34.763	12.937	2322395	2487670	5/29/1998	07:03:42.42	3.797	7.745
217	45.686	18.057	0.166	34.766	12.939	2297551	2487695	5/29/1998	07:09:43.22	3.627	7.746
218	45.721	18.102	0.156	34.758	12.936	2334395	2487626	5/29/1998	07:15:44.02	3.879	7.745
219	45.766	18.14	0.185	34.765	12.939	2357319	2487050	5/29/1998	07:21:44.82	4.037	7.743
220	45.802	18.177	0.195	34.764	12.939	2310795	2487153	5/29/1998	07:27:45.62	3.717	7.743
221	45.838	18.217	0.221	34.76	12.938	2304781	2486748	5/29/1998	07:33:46.42	3.676	7.741
222	45.881	18.255	0.237	34.765	12.937	2374486	2486894	5/29/1998	07:39:47.22	4.155	7.742
223	45.91	18.293	0.255	34.757	12.94	2358374	2486404	5/29/1998	07:45:48.02	4.044	7.740
224	45.943	18.326	0.254	34.758	12.939	2355086	2486334	5/29/1998	07:51:48.82	4.021	7.740
225	45.976	18.356	0.27	34.759	12.94	2289219	2486584	5/29/1998	07:57:49.62	3.569	7.741
226	46.006	18.39	0.296	34.756	12.937	2331209	2486612	5/29/1998	08:03:50.42	3.858	7.741
227	46.037	18.426	0.316	34.751	12.939	2348303	2486396	5/29/1998	08:09:51.22	3.975	7.740
228	46.055	18.446	0.312	34.75	12.937	2260793	2486816	5/29/1998	08:15:52.02	3.374	7.742
229	46.087	18.47	0.341	34.757	12.938	2361113	2486006	5/29/1998	08:21:52.82	4.063	7.738
230	46.116	18.501	0.397	34.755	12.937	2242313	2486667	5/29/1998	08:27:53.62	3.247	7.741
231	46.141	18.525	0.396	34.756	12.935	2325640	2486151	5/29/1998	08:33:54.42	3.819	7.739
232	46.16	18.543	0.402	34.756	12.937	2334223	2486496	5/29/1998	08:39:55.22	3.878	7.740
233	46.174	18.564	0.483	34.751	12.936	2352298	2486551	5/29/1998	08:45:56.02	4.002	7.741
234	46.194	18.577	0.461	34.757	12.936	2334808	2486328	5/29/1998	08:51:56.82	3.882	7.740
235	46.198	18.582	0.484	34.756	12.936	2320176	2485657	5/29/1998	08:57:57.62	3.782	7.737
236	46.196	18.577	0.515	34.758	12.935	2273956	2485540	5/29/1998	09:03:58.42	3.465	7.736
237	46.188	18.582	0.542	34.747	12.934	2371515	2485166	5/29/1998	09:09:59.22	4.134	7.735
238	46.179	18.563	0.528	34.755	12.934	2359711	2485938	5/29/1998	09:16:00.02	4.053	7.738
239	46.16	18.544	0.592	34.756	12.933	2390262	2485802	5/29/1998	09:22:00.82	4.263	7.737
240	46.146	18.524	0.607	34.761	12.936	2376076	2484909	5/29/1998	09:28:01.62	4.165	7.734
241	46.122	18.508	0.608	34.754	12.932	2346540	2485726	5/29/1998	09:34:02.42	3.963	7.737
242	46.11	18.494	0.679	34.756	12.931	2271082	2485496	5/29/1998	09:40:03.22	3.445	7.736
243	46.098	18.49	0.659	34.748	12.931	2342790	2484503	5/29/1998	09:46:04.02	3.937	7.732
244	46.083	18.473	0.689	34.751	12.932	2360399	2484808	5/29/1998	09:52:04.82	4.058	7.733
245	46.071	18.451	0.764	34.759	12.93	2359366	2485051	5/29/1998	09:58:05.62	4.051	7.734
246	46.057	18.44	0.802	34.757	12.93	2339065	2485960	5/29/1998	10:04:06.42	3.911	7.738
247	46.039	18.429	0.778	34.751	12.929	2374929	2485450	5/29/1998	10:10:07.22	4.158	7.736
248	46.033	18.419	0.823	34.755	12.931	2380206	2485436	5/29/1998	10:16:08.02	4.194	7.736
249	46.026	18.406	0.877	34.759	12.931	2347044	2484886	5/29/1998	10:22:08.82	3.966	7.733

Record No.	Conductivity (mS/cm)	Temperature (Deg. C)	Pressure (dBar)	Salinity (PSU)	CTD Bat. (Vdc)	D.O. (Integer)	pH (Integer)	Date	Time	D.O. (ml/L)	pH (Value)
250	46.012	18.396	0.896	34.756	12.928	2355055	2485252	5/29/1998	10:28:09.62	4.021	7.735
251	45.995	18.378	0.951	34.756	12.928	2327764	2485243	5/29/1998	10:34:10.42	3.834	7.735
252	45.973	18.355	0.923	34.757	12.927	2380058	2484446	5/29/1998	10:40:11.22	4.193	7.732
253	45.948	18.336	0.969	34.752	12.906	2359418	2483853	5/29/1998	10:46:12.02	4.051	7.729
254	45.93	18.307	0.962	34.762	12.919	2348663	2485031	5/29/1998	10:52:12.82	3.977	7.734
255	45.892	18.271	1.029	34.759	12.918	2350833	2484387	5/29/1998	10:58:13.62	3.992	7.731
256	45.858	18.234	1.051	34.762	12.919	2329614	2484429	5/29/1998	11:04:14.42	3.847	7.731
257	45.822	18.198	1.064	34.762	12.92	2372916	2484444	5/29/1998	11:10:15.22	4.144	7.731
258	45.801	18.173	1.079	34.765	12.919	2342223	2484663	5/29/1998	11:16:16.02	3.933	7.732
259	45.77	18.143	1.107	34.764	12.918	2350212	2484551	5/29/1998	11:22:16.82	3.988	7.732
260	45.725	18.102	1.137	34.762	12.918	2295768	2484156	5/29/1998	11:28:17.62	3.614	7.730
261	45.672	18.049	1.166	34.761	12.918	2360195	2484763	5/29/1998	11:34:18.42	4.056	7.733
262	45.623	17.988	1.152	34.772	12.918	2325052	2484259	5/29/1998	11:40:19.22	3.815	7.731
263	45.567	17.947	1.168	34.758	12.915	2360377	2484336	5/29/1998	11:46:20.02	4.058	7.731
264	45.498	17.867	1.2	34.768	12.915	2345574	2484232	5/29/1998	11:52:20.82	3.956	7.731
265	45.429	17.793	1.221	34.772	12.913	2335963	2484171	5/29/1998	11:58:21.62	3.890	7.730
266	45.386	17.752	1.233	34.77	12.914	2372696	2484228	5/29/1998	12:04:22.42	4.142	7.731
267	45.334	17.698	1.292	34.772	12.913	2228506	2483885	5/29/1998	12:10:23.22	3.153	7.729
268	45.285	17.653	1.265	34.768	12.912	2321059	2484050	5/29/1998	12:16:24.02	3.788	7.730
269	45.252	17.609	1.294	34.777	12.912	2344872	2484538	5/29/1998	12:22:24.82	3.951	7.732
270	45.214	17.566	1.278	34.781	12.911	2370115	2484017	5/29/1998	12:28:25.62	4.125	7.730
271	45.163	17.518	1.302	34.779	12.911	2323027	2484582	5/29/1998	12:34:26.42	3.801	7.732
272	45.115	17.482	1.279	34.768	12.909	2343015	2484452	5/29/1998	12:40:27.22	3.939	7.732
273	45.081	17.447	1.299	34.768	12.908	2339927	2484048	5/29/1998	12:46:28.02	3.917	7.730
274	45.049	17.416	1.3	34.767	12.909	2336933	2484086	5/29/1998	12:52:28.82	3.897	7.730
275	45.034	17.385	1.287	34.781	12.909	2342602	2484079	5/29/1998	12:58:29.62	3.936	7.730
276	45.007	17.356	1.356	34.782	12.908	2301207	2483829	5/29/1998	13:04:30.42	3.652	7.729
277	44.977	17.326	1.372	34.783	12.908	2319952	2483977	5/29/1998	13:10:31.22	3.780	7.729
278	44.946	17.296	1.333	34.782	12.907	2332314	2484063	5/29/1998	13:16:32.02	3.865	7.730
279	44.918	17.271	1.364	34.779	12.907	2338066	2483642	5/29/1998	13:22:32.82	3.905	7.728
280	44.89	17.239	1.328	34.782	12.905	2340330	2484771	5/29/1998	13:28:33.62	3.920	7.733
281	44.851	17.202	1.309	34.781	12.905	2297767	2484638	5/29/1998	13:34:34.42	3.628	7.732
282	44.811	17.158	1.289	34.784	12.902	2337772	2484419	5/29/1998	13:41:16.46	3.903	7.731
283	44.786	17.13	1.28	34.786	12.903	2332777	2483267	5/29/1998	13:47:17.26	3.868	7.726
284	44.761	17.117	1.305	34.775	12.903	2343545	2483895	5/29/1998	13:53:18.06	3.942	7.729
285	44.712	17.05	1.31	34.791	12.902	2339659	2483953	5/29/1998	13:59:18.86	3.916	7.729
286	44.673	17.009	1.298	34.792	12.901	2321547	2484309	5/29/1998	14:05:19.66	3.791	7.731
287	44.639	16.982	1.33	34.786	12.903	2327921	2483368	5/29/1998	14:11:20.46	3.835	7.727
288	44.607	16.95	1.256	34.785	12.9	2312211	2484264	5/29/1998	14:17:21.26	3.727	7.731
289	44.598	16.924	1.228	34.8	12.901	2327343	2484037	5/29/1998	14:23:22.06	3.831	7.730
290	44.564	16.908	1.224	34.784	12.901	2341677	2483301	5/29/1998	14:29:22.86	3.929	7.727
291	44.536	16.867	1.17	34.795	12.899	2315049	2483388	5/29/1998	14:35:23.66	3.747	7.727
292	44.513	16.851	1.198	34.789	12.898	2329209	2483680	5/29/1998	14:41:24.46	3.844	7.728
293	44.478	16.822	1.231	34.783	12.9	2335562	2483394	5/29/1998	14:47:25.26	3.887	7.727
294	44.451	16.792	1.222	34.786	12.897	2338998	2483843	5/29/1998	14:53:26.06	3.911	7.729
295	44.42	16.75	1.193	34.795	12.9	2324411	2483427	5/29/1998	14:59:26.86	3.811	7.727
296	44.399	16.732	1.145	34.793	12.898	2304612	2484513	5/29/1998	15:05:27.66	3.675	7.732
297	44.364	16.703	1.1	34.786	12.883	2292713	2484593	5/29/1998	15:11:28.46	3.593	7.732
298	44.357	16.668	1.042	34.811	12.888	2308925	2484349	5/29/1998	15:17:29.26	3.705	7.731
299	44.349	16.674	1.108	34.799	12.89	2327934	2484425	5/29/1998	15:23:30.06	3.835	7.731
300	44.34	16.665	1.097	34.798	12.891	2282372	2483891	5/29/1998	15:29:30.86	3.522	7.729
301	44.316	16.646	1.05	34.795	12.892	2315451	2483857	5/29/1998	15:35:31.66	3.749	7.729
302	44.3	16.619	1.033	34.804	12.893	2251383	2483779	5/29/1998	15:41:32.46	3.310	7.729
303	44.283	16.606	1.085	34.8	12.891	2307209	2484265	5/29/1998	15:47:33.26	3.693	7.731
304	44.272	16.592	1.042	34.803	12.891	2332659	2483848	5/29/1998	15:53:34.06	3.867	7.729
305	44.257	16.582	0.982	34.798	12.89	2341376	2484169	5/29/1998	15:59:34.86	3.927	7.730
306	44.228	16.553	0.977	34.798	12.89	2313749	2483931	5/29/1998	16:05:35.66	3.738	7.729
307	44.201	16.521	0.959	34.802	12.89	2330583	2484105	5/29/1998	16:11:36.46	3.853	7.730
308	44.187	16.509	0.923	34.8	12.889	2303860	2484190	5/29/1998	16:17:37.26	3.670	7.730
309	44.176	16.493	0.932	34.804	12.89	2343082	2484519	5/29/1998	16:23:38.06	3.939	7.732
310	44.151	16.467	0.888	34.805	12.888	2343922	2484486	5/29/1998	16:29:38.86	3.945	7.732
311	44.128	16.456	0.881	34.794	12.888	2312010	2485232	5/29/1998	16:35:39.66	3.726	7.735
312	44.127	16.449	0.912	34.799	12.887	2322480	2484327	5/29/1998	16:41:40.46	3.798	7.731
313	44.142	16.468	0.873	34.796	12.889	2315096	2485002	5/29/1998	16:47:41.26	3.747	7.734
314	44.173	16.499	0.837	34.796	12.889	2348395	2485131	5/29/1998	16:53:42.06	3.975	7.734
315	44.191	16.515	0.87	34.798	12.891	2335403	2485378	5/29/1998	16:59:42.86	3.886	7.736
316	44.208	16.533	0.83	34.798	12.891	2330302	2486136	5/29/1998	17:05:43.66	3.851	7.739
317	44.25	16.573	0.852	34.799	12.892	2307566	2486248	5/29/1998	17:11:44.46	3.695	7.739
318	44.286	16.61	0.825	34.8	12.891	2330960	2486217	5/29/1998	17:17:45.26	3.856	7.739
319	44.32	16.644	0.8	34.8	12.892	2332307	2486066	5/29/1998	17:23:46.06	3.865	7.738
320	44.359	16.685	0.741	34.798	12.892	2320140	2486059	5/29/1998	17:29:46.86	3.782	7.738
321	44.393	16.731	0.788	34.789	12.892	2257174	2486583	5/29/1998	17:35:47.66	3.349	7.741
322	44.446	16.761	0.774	34.808	12.891	2338630	2485621	5/29/1998	17:41:48.46	3.908	7.737
323	44.483	16.804	0.821	34.803	12.891	2327171	2486514	5/29/1998	17:47:49.26	3.830	7.740
324	44.519	16.85	0.808	34.796	12.893	2338304	2486065	5/29/1998	17:53:50.06	3.906	7.738
325	44.557	16.884	0.787	34.798	12.892	2343962	2486671	5/29/1998	17:59:50.86	3.945	7.741
326	44.604	16.923	0.815	34.807	12.892	2355998	2486419	5/29/1998	18:05:51.66	4.028	7.740
327	44.638	16.979	0.782	34.787	12.895	2341730	2486646	5/29/1998	18:11:52.46	3.930	7.741
328	44.674	17.01	0.787	34.793	12.893	2296214	2487235	5/29/1998	18:17:53.26	3.617	7.744
329	44.711	17.052	0.762	34.788	12.892	2331940	2487590	5/29/1998	18:23:54.06	3.863	7.745
330	44.742	17.087	0.794	34.785	12.892	2348959	2487156	5/29/1998	18:29:54.86	3.979	7.743
331	44.771	17.113	0.81	34.787	12.892	2320873	2487392	5/29/1998	18:35:55.66	3.787	7.744
332	44.783	17.12	0.776	34.792	12.892	2322974	2486786	5/29/1998	18:41:56.46	3.801	7.742
333	44.794	17.136	0.795	34.788	12.892	2336199	2486699	5/29/1998	18:47:57.26	3.892	7.741
334	44.809	17.151	0.777	34.787	12.892	2321517	2487226	5/29/1998	18:53:58.06	3.791	7.744
335	44.835	17.179	0.82	34.786	12.892	2204881	2487495	5/29/1998	18:59:58.86	2.991	7.745
336	44.849	17.205	0.796	34.776	12.892	2327373	2487420	5/29/1998	19:05:59.66	3.831	7.744
337	44.861	17.208	0.765	34.784	12.893	2343211	2487378	5/29/1998	19:12:00.46	3.940	7.744
338	44.869	17.225	0.749	34.776	12.893	2334512	2487949	5/29/1998	19:18:01.26	3.880	7.747
339	44.901	17.238	0.768	34.793	12.89	2301201	2488307	5/29/1998	19:24:02.06	3.652	7.748
340	44.929	17.266	0.828	34.793	12.891	2348669	2487450	5/29/1998	19:30:02.86	3.977	7.744
341	44.925	17.282	0.876	34.776	12.891	2337543	2488202	5/29/1998	19:36:03.66	3.901	7.748
342	44.923	17.27	0.874	34.784	12.889	2326310	2487967	5/29/1998	19:42:04.46	3.824	7.747
343	44.929	17.262	0.9	34.796	12.889	2313199	2487320	5/29/1998	19:48:05.26	3.734	7.744

Record No.	Conductivity (mS/cm)	Temperature (Deg. C)	Pressure (dBar)	Salinity (PSU)	CTD Bat. (Vdc)	D.O. (Integer)	pH (Integer)	Date	Time	D.O. (ml/L)	pH (Value)
344	44.934	17.277	0.838	34.788	12.89	2352186	2487869	5/29/1998	19:54:06.06	4.002	7.746
345	44.939	17.277	0.9	34.792	12.888	2315448	2487883	5/29/1998	20:00:06.86	3.749	7.746
346	44.919	17.267	0.909	34.783	12.889	2353717	2487396	5/29/1998	20:06:07.66	4.012	7.744
347	44.913	17.253	0.88	34.79	12.888	2346549	2488178	5/29/1998	20:12:08.46	3.963	7.748
348	44.919	17.255	0.869	34.793	12.888	2336872	2487929	5/29/1998	20:18:09.26	3.896	7.747
349	44.917	17.254	0.894	34.793	12.889	2325632	2488405	5/29/1998	20:24:10.06	3.819	7.749
350	44.896	17.244	0.95	34.783	12.889	2334058	2488291	5/29/1998	20:30:10.86	3.877	7.748
351	44.879	17.226	0.984	34.784	12.887	2311488	2488567	5/29/1998	20:36:11.66	3.722	7.749
352	44.859	17.194	1.012	34.794	12.886	2341039	2487927	5/29/1998	20:42:53.70	3.925	7.747
353	44.844	17.181	0.997	34.792	12.885	2344434	2487600	5/29/1998	20:48:54.50	3.948	7.745
354	44.831	17.16	1.025	34.799	12.886	2337312	2488011	5/29/1998	20:54:55.30	3.899	7.747
355	44.813	17.153	1.01	34.789	12.886	2338198	2487658	5/29/1998	21:00:56.10	3.906	7.745
356	44.794	17.127	1.052	34.796	12.884	2344105	2488237	5/29/1998	21:06:56.90	3.946	7.748
357	44.783	17.118	1.028	34.794	12.886	2325453	2487986	5/29/1998	21:12:57.70	3.818	7.747
358	44.77	17.102	1.037	34.796	12.884	2331893	2488251	5/29/1998	21:18:58.50	3.862	7.748
359	44.742	17.079	1.109	34.791	12.883	2340829	2488391	5/29/1998	21:24:59.30	3.924	7.749
360	44.712	17.041	1.096	34.798	12.883	2321772	2488392	5/29/1998	21:31:00.10	3.793	7.749
361	44.673	17.014	1.13	34.788	12.882	2309981	2487718	5/29/1998	21:37:00.90	3.712	7.746
362	44.657	16.995	1.073	34.79	12.881	2339121	2487849	5/29/1998	21:43:01.70	3.912	7.746
363	44.637	16.974	1.173	34.791	12.881	2342414	2488280	5/29/1998	21:49:02.50	3.934	7.748
364	44.597	16.914	1.143	34.808	12.882	2315806	2487417	5/29/1998	21:55:03.30	3.752	7.744
365	44.551	16.87	1.17	34.806	12.879	2307752	2487611	5/29/1998	22:01:04.10	3.697	7.745
366	44.518	16.842	1.205	34.801	12.88	2361652	2487055	5/29/1998	22:07:04.90	4.066	7.743
367	44.492	16.802	1.156	34.814	12.878	2303127	2487274	5/29/1998	22:13:05.70	3.665	7.744
368	44.449	16.774	1.224	34.8	12.88	2330282	2486967	5/29/1998	22:19:06.50	3.851	7.742
369	44.407	16.728	1.246	34.802	12.877	2314107	2486463	5/29/1998	22:25:07.30	3.740	7.740
370	44.371	16.693	1.24	34.802	12.878	2323078	2487037	5/29/1998	22:31:08.10	3.802	7.743
371	44.34	16.665	1.237	34.799	12.876	2336920	2487277	5/29/1998	22:37:08.90	3.897	7.744
372	44.317	16.632	1.307	34.807	12.877	2293848	2487169	5/29/1998	22:43:09.70	3.601	7.743
373	44.281	16.605	1.295	34.799	12.875	2322162	2486511	5/29/1998	22:49:10.50	3.795	7.740
374	44.237	16.564	1.335	34.796	12.878	2329379	2486668	5/29/1998	22:55:11.30	3.845	7.741
375	44.221	16.536	1.283	34.806	12.875	2342634	2486745	5/29/1998	23:01:12.10	3.936	7.741
376	44.209	16.522	1.326	34.808	12.876	2322352	2486988	5/29/1998	23:07:12.90	3.797	7.742
377	44.179	16.504	1.307	34.798	12.874	2328236	2486675	5/29/1998	23:13:13.70	3.837	7.741
378	44.162	16.468	1.334	34.813	12.873	2314743	2486843	5/29/1998	23:19:14.50	3.745	7.742
379	44.149	16.471	1.319	34.799	12.874	2332417	2487581	5/29/1998	23:25:15.30	3.866	7.745
380	44.145	16.456	1.334	34.809	12.873	2307129	2486943	5/29/1998	23:31:16.10	3.692	7.742
381	44.131	16.441	1.366	34.81	12.873	2318263	2486990	5/29/1998	23:37:16.90	3.769	7.742
382	44.113	16.423	1.386	34.809	12.873	2307490	2486819	5/29/1998	23:43:17.70	3.695	7.742
383	44.104	16.419	1.387	34.805	12.872	2313981	2486828	5/29/1998	23:49:18.50	3.739	7.742
384	44.094	16.409	1.371	34.805	12.873	2319829	2486829	5/29/1998	23:55:19.30	3.779	7.742
385	44.085	16.394	1.402	34.811	12.873	2305087	2486923	5/30/1998	00:01:20.10	3.678	7.742
386	44.086	16.395	1.377	34.81	12.874	2316024	2486774	5/30/1998	00:07:20.90	3.753	7.742
387	44.08	16.384	1.409	34.815	12.872	2319964	2486620	5/30/1998	00:13:21.70	3.780	7.741
388	44.068	16.385	1.369	34.803	12.87	2334457	2486747	5/30/1998	00:19:22.50	3.880	7.741
389	44.071	16.377	1.432	34.812	12.871	2312238	2487028	5/30/1998	00:25:23.30	3.727	7.743
390	44.064	16.376	1.384	34.807	12.871	2325207	2486925	5/30/1998	00:31:24.10	3.816	7.742
391	44.062	16.366	1.468	34.815	12.87	2326876	2486570	5/30/1998	00:37:24.90	3.828	7.741
392	44.042	16.339	1.408	34.82	12.869	2328580	2486519	5/30/1998	00:43:25.70	3.839	7.740
393	44.029	16.338	1.329	34.81	12.869	2310907	2486439	5/30/1998	00:49:26.50	3.718	7.740
394	44.016	16.322	1.368	34.812	12.868	2293417	2486540	5/30/1998	00:55:27.30	3.598	7.741
395	44.009	16.32	1.374	34.807	12.868	2333263	2486925	5/30/1998	01:01:28.10	3.872	7.742
396	44.002	16.306	1.333	34.814	12.867	2326284	2486499	5/30/1998	01:07:28.90	3.824	7.740
397	43.996	16.298	1.346	34.815	12.867	2293722	2486428	5/30/1998	01:13:29.70	3.600	7.740
398	43.977	16.281	1.36	34.814	12.866	2305563	2486510	5/30/1998	01:19:30.50	3.682	7.740
399	43.965	16.269	1.286	34.813	12.866	2315140	2486732	5/30/1998	01:25:31.30	3.747	7.741
400	43.965	16.264	1.314	34.818	12.865	2287957	2486861	5/30/1998	01:31:32.10	3.561	7.742
401	43.952	16.253	1.196	34.815	12.866	2324126	2486300	5/30/1998	01:37:32.90	3.809	7.740
402	43.94	16.248	1.21	34.81	12.865	2301704	2487269	5/30/1998	01:43:33.70	3.655	7.744
403	43.934	16.233	1.171	34.818	12.865	2332119	2486575	5/30/1998	01:49:34.50	3.864	7.741
404	43.923	16.222	1.166	34.817	12.865	2283408	2486310	5/30/1998	01:55:35.30	3.529	7.740
405	43.913	16.215	1.127	34.814	12.865	2307587	2486227	5/30/1998	02:01:36.10	3.695	7.739
406	43.904	16.201	1.14	34.818	12.866	2267912	2486592	5/30/1998	02:07:36.90	3.423	7.741
407	43.888	16.187	1.092	34.816	12.866	2313204	2486313	5/30/1998	02:13:37.70	3.734	7.740
408	43.886	16.185	1.067	34.816	12.863	2326112	2486193	5/30/1998	02:19:38.50	3.823	7.739
409	43.882	16.173	1.018	34.824	12.864	2325764	2486166	5/30/1998	02:25:39.30	3.820	7.739
410	43.875	16.165	1.034	34.825	12.863	2293219	2486536	5/30/1998	02:31:40.10	3.597	7.741
411	43.871	16.171	0.956	34.816	12.862	2296363	2486374	5/30/1998	02:37:40.90	3.618	7.740
412	43.867	16.168	0.914	34.814	12.864	2313071	2486533	5/30/1998	02:43:41.70	3.733	7.741
413	43.874	16.169	0.913	34.819	12.864	2312193	2486292	5/30/1998	02:49:42.50	3.727	7.739
414	43.881	16.176	0.883	34.821	12.864	2301838	2486400	5/30/1998	02:55:43.30	3.656	7.740
415	43.892	16.187	0.889	34.821	12.864	2321676	2486633	5/30/1998	03:01:44.10	3.792	7.741
416	43.9	16.2	0.794	34.816	12.863	2316388	2486546	5/30/1998	03:07:44.90	3.756	7.741
417	43.906	16.204	0.678	34.818	12.864	2293921	2486201	5/30/1998	03:13:45.70	3.602	7.739
418	43.917	16.223	0.677	34.812	12.861	2305287	2487239	5/30/1998	03:19:46.50	3.680	7.744
419	43.932	16.225	0.72	34.822	12.86	2298005	2486506	5/30/1998	03:25:47.30	3.630	7.740
420	43.962	16.262	0.666	34.817	12.862	2326747	2487258	5/30/1998	03:31:48.10	3.827	7.744
421	43.997	16.306	0.616	34.81	12.864	2302305	2486826	5/30/1998	03:37:48.90	3.659	7.742
422	44.009	16.319	0.564	34.809	12.861	2322062	2488345	5/30/1998	03:44:30.95	3.795	7.748
423	44.026	16.337	0.556	34.808	12.861	2306504	2486669	5/30/1998	03:50:31.75	3.688	7.741
424	44.061	16.362	0.572	34.817	12.862	2314844	2487926	5/30/1998	03:56:32.55	3.745	7.747
425	44.095	16.398	0.486	34.815	12.862	2310070	2487092	5/30/1998	04:02:33.35	3.712	7.743
426	44.116	16.423	0.442	34.813	12.861	2296476	2487592	5/30/1998	04:08:34.15	3.619	7.745
427	44.119	16.414	0.365	34.824	12.861	2318347	2487428	5/30/1998	04:14:34.95	3.769	7.744
428	44.145	16.434	0.397	34.829	12.861	2307337	2486583	5/30/1998	04:20:35.75	3.694	7.741
429	44.174	16.475	0.383	34.819	12.862	2294535	2487564	5/30/1998	04:26:36.55	3.606	7.745
430	44.191	16.491	0.36	34.819	12.862	2300837	2487137	5/30/1998	04:32:37.35	3.649	7.743
431	44.203	16.495	0.288	34.827	12.862	2318227	2487116	5/30/1998	04:38:38.15	3.768	7.743
432	44.212	16.517	0.237	34.815	12.862	2289925	2486807	5/30/1998	04:44:38.95	3.574	7.742
433	44.218	16.511	0.252	34.826	12.861	2304591	2487024	5/30/1998	04:50:39.75	3.675	7.743
434	44.245	16.555	0.206	34.811	12.862	2324413	2487383	5/30/1998	04:56:40.55	3.811	7.744
435	44.265	16.557	0.177	34.826	12.861	2317846	2486946	5/30/1998	05:02:41.35	3.766	7.742
436	44.277	16.588	0.15	34.811	12.861	2308299	2487312	5/30/1998	05:08:42.15	3.700	7.744
437	44.279	16.593	0.122	34.808	12.861	2314803	2487202	5/30/1998	05:14:42.95	3.745	7.743

Record No.	Conductivity (mS/cm)	Temperature (Deg. C)	Pressure (dBar)	Salinity (PSU)	CTD Bat. (Vdc)	D.O. (Integer)	pH (Integer)	Date	Time	D.O. (ml/L)	pH (Value)
438	44.305	16.613	0.072	34.813	12.86	2309705	2488027	5/30/1998	05:20:43.75	3.710	7.747
439	44.337	16.648	0.058	34.811	12.863	2312600	2486801	5/30/1998	05:26:44.55	3.730	7.742
440	44.37	16.683	0.013	34.81	12.862	2319516	2487222	5/30/1998	05:32:45.35	3.777	7.743
441	44.39	16.691	0.003	34.82	12.861	2330909	2487368	5/30/1998	05:38:46.15	3.855	7.744
442	44.417	16.727	-0.102	34.813	12.861	2315582	2486676	5/30/1998	05:44:46.95	3.750	7.741
443	44.456	16.764	-0.029	34.814	12.862	2328682	2487264	5/30/1998	05:50:47.75	3.840	7.744
444	44.491	16.812	-0.061	34.804	12.861	2327159	2486847	5/30/1998	05:56:48.55	3.830	7.742
445	44.533	16.851	-0.082	34.808	12.861	2319389	2486671	5/30/1998	06:02:49.35	3.776	7.741
446	44.579	16.904	-0.11	34.802	12.862	2340800	2486539	5/30/1998	06:08:50.15	3.923	7.741
447	44.617	16.936	-0.13	34.807	12.863	2246282	2486725	5/30/1998	06:14:50.95	3.275	7.741
448	44.657	16.974	-0.157	34.809	12.862	2331076	2486679	5/30/1998	06:20:51.75	3.857	7.741
449	44.697	17.016	-0.144	34.807	12.863	2307462	2486032	5/30/1998	06:26:52.55	3.695	7.738
450	44.733	17.06	-0.206	34.801	12.863	2336385	2486240	5/30/1998	06:32:53.35	3.893	7.739
451	44.776	17.098	-0.196	34.805	12.863	2335998	2486472	5/30/1998	06:38:54.15	3.890	7.740
452	44.811	17.13	-0.192	34.808	12.864	2330003	2485547	5/30/1998	06:44:54.95	3.849	7.736
453	44.843	17.169	-0.2	34.802	12.863	2326793	2485960	5/30/1998	06:50:55.75	3.827	7.738
454	44.882	17.208	-0.233	34.802	12.862	2298696	2486696	5/30/1998	06:56:56.55	3.634	7.741
455	44.921	17.25	-0.22	34.801	12.864	2316551	2485880	5/30/1998	07:02:57.35	3.757	7.738
456	44.957	17.295	-0.223	34.793	12.864	2342717	2486263	5/30/1998	07:08:58.15	3.937	7.739
457	44.988	17.324	-0.272	34.795	12.864	2330527	2485781	5/30/1998	07:14:58.95	3.853	7.737
458	45.027	17.362	-0.259	34.796	12.864	2332861	2485152	5/30/1998	07:20:59.75	3.869	7.735
459	45.06	17.388	-0.261	34.802	12.864	2341392	2484661	5/30/1998	07:27:00.55	3.927	7.732
460	45.081	17.419	-0.244	34.793	12.864	2330915	2484858	5/30/1998	07:33:01.35	3.856	7.733
461	45.125	17.449	-0.26	34.805	12.864	2343651	2484480	5/30/1998	07:39:02.15	3.943	7.732
462	45.164	17.494	-0.278	34.801	12.865	2347319	2483959	5/30/1998	07:45:02.95	3.968	7.729
463	45.201	17.531	-0.253	34.8	12.864	2345763	2484574	5/30/1998	07:51:03.75	3.957	7.732
464	45.229	17.567	-0.213	34.794	12.865	2333827	2485000	5/30/1998	07:57:04.55	3.876	7.734
465	45.269	17.613	-0.222	34.789	12.865	2330157	2484141	5/30/1998	08:03:05.35	3.850	7.730
466	45.3	17.641	-0.229	34.791	12.864	2336285	2484280	5/30/1998	08:09:06.15	3.892	7.731
467	45.337	17.67	-0.201	34.799	12.864	2331750	2484503	5/30/1998	08:15:06.95	3.861	7.732
468	45.354	17.691	-0.207	34.795	12.865	2348329	2484304	5/30/1998	08:21:07.75	3.975	7.731
469	45.392	17.736	-0.203	34.788	12.865	2360376	2483506	5/30/1998	08:27:08.55	4.058	7.727
470	45.421	17.764	-0.168	34.79	12.865	2352150	2483437	5/30/1998	08:33:09.35	4.001	7.727
471	45.446	17.794	-0.152	34.786	12.867	2343306	2483485	5/30/1998	08:39:10.15	3.941	7.727
472	45.48	17.821	-0.144	34.792	12.865	2321326	2483656	5/30/1998	08:45:10.95	3.790	7.728
473	45.51	17.856	-0.144	34.787	12.867	2372649	2483256	5/30/1998	08:51:11.75	4.142	7.726
474	45.537	17.877	-0.081	34.793	12.865	2337480	2483380	5/30/1998	08:57:12.55	3.901	7.727
475	45.559	17.903	-0.106	34.79	12.865	2356705	2482860	5/30/1998	09:03:13.35	4.033	7.725
476	45.584	17.93	-0.075	34.788	12.865	2343080	2483003	5/30/1998	09:09:14.15	3.939	7.725
477	45.601	17.954	-0.076	34.782	12.866	2357706	2483258	5/30/1998	09:15:14.95	4.039	7.726
478	45.621	17.97	-0.035	34.785	12.866	2342494	2483321	5/30/1998	09:21:15.75	3.935	7.727
479	45.636	17.978	-0.017	34.792	12.867	2343084	2483467	5/30/1998	09:27:16.55	3.939	7.727
480	45.642	17.989	0.008	34.787	12.866	2345917	2483405	5/30/1998	09:33:17.35	3.958	7.727
481	45.65	17.996	0.004	34.788	12.864	2324748	2483245	5/30/1998	09:39:18.15	3.813	7.726
482	45.652	18.004	0.014	34.783	12.868	2351747	2483031	5/30/1998	09:45:18.95	3.998	7.725
483	45.66	18.009	0.081	34.786	12.863	2345949	2483732	5/30/1998	09:51:19.75	3.959	7.728
484	45.662	18.018	0.08	34.779	12.864	2362031	2483083	5/30/1998	09:57:20.55	4.069	7.726
485	45.666	18.017	0.092	34.784	12.865	2374991	2483133	5/30/1998	10:03:21.35	4.158	7.726
486	45.684	18.029	0.115	34.789	12.864	2366854	2482706	5/30/1998	10:09:22.15	4.102	7.724
487	45.692	18.046	0.149	34.781	12.863	2338731	2482179	5/30/1998	10:15:22.95	3.909	7.722
488	45.703	18.051	0.176	34.786	12.865	2354646	2482331	5/30/1998	10:21:23.75	4.018	7.722
489	45.707	18.058	0.207	34.784	12.864	2353211	2482325	5/30/1998	10:27:24.55	4.009	7.722
490	45.714	18.063	0.236	34.785	12.863	2348101	2482263	5/30/1998	10:33:25.35	3.973	7.722
491	45.705	18.051	0.197	34.788	12.865	2359616	2481648	5/30/1998	10:39:26.15	4.052	7.719
492	45.684	18.035	0.25	34.783	12.865	2251659	2481928	5/30/1998	10:46:08.20	3.312	7.721
493	45.669	18.016	0.327	34.787	12.861	2356701	2482500	5/30/1998	10:52:09.00	4.032	7.723
494	45.643	17.987	0.339	34.79	12.861	2327437	2481881	5/30/1998	10:58:09.80	3.832	7.720
495	45.625	17.973	0.34	34.786	12.86	2344082	2482078	5/30/1998	11:04:10.60	3.946	7.721
496	45.608	17.952	0.372	34.789	12.859	2331848	2482260	5/30/1998	11:10:11.40	3.862	7.722
497	45.587	17.938	0.341	34.784	12.859	2280028	2482564	5/30/1998	11:16:12.20	3.506	7.723
498	45.57	17.914	0.4	34.789	12.859	2332656	2481978	5/30/1998	11:22:13.00	3.867	7.721
499	45.549	17.9	0.418	34.783	12.86	2357642	2481849	5/30/1998	11:28:13.80	4.039	7.720
500	45.538	17.882	0.444	34.789	12.859	2330851	2481623	5/30/1998	11:34:14.60	3.855	7.719
501	45.521	17.871	0.452	34.784	12.859	2344205	2481926	5/30/1998	11:40:15.40	3.947	7.721
502	45.5	17.84	0.488	34.793	12.857	2342044	2481678	5/30/1998	11:46:16.20	3.932	7.720
503	45.469	17.819	0.55	34.783	12.858	2353370	2481840	5/30/1998	11:52:17.00	4.010	7.720
504	45.444	17.789	0.534	34.788	12.857	2334722	2481668	5/30/1998	11:58:17.80	3.882	7.719
505	45.424	17.767	0.555	34.789	12.858	2341054	2481409	5/30/1998	12:04:18.60	3.925	7.718
506	45.4	17.738	0.568	34.795	12.856	2319566	2482194	5/30/1998	12:10:19.40	3.778	7.722
507	45.388	17.736	0.581	34.786	12.856	2368102	2482065	5/30/1998	12:16:20.20	4.111	7.721
508	45.374	17.713	0.63	34.793	12.856	2336151	2481421	5/30/1998	12:22:21.00	3.891	7.718
509	45.356	17.694	0.65	34.794	12.856	2330657	2481885	5/30/1998	12:28:21.80	3.854	7.720
510	45.334	17.675	0.635	34.791	12.855	2338667	2481710	5/30/1998	12:34:22.60	3.909	7.720
511	45.328	17.665	0.679	34.794	12.855	2338739	2481293	5/30/1998	12:40:23.40	3.909	7.718
512	45.322	17.668	0.678	34.787	12.854	2341819	2481339	5/30/1998	12:46:24.20	3.930	7.718
513	45.312	17.654	0.706	34.79	12.855	2305778	2481554	5/30/1998	12:52:25.00	3.683	7.719
514	45.306	17.651	0.719	34.787	12.854	2355741	2480928	5/30/1998	12:58:25.80	4.026	7.716
515	45.296	17.631	0.747	34.796	12.854	2352447	2481637	5/30/1998	13:04:26.60	4.003	7.719
516	45.276	17.613	0.785	34.795	12.853	2345655	2481495	5/30/1998	13:10:27.40	3.957	7.719
517	45.232	17.569	0.769	34.794	12.852	2343949	2481561	5/30/1998	13:16:28.20	3.945	7.719
518	45.194	17.536	0.767	34.789	12.852	2316763	2482495	5/30/1998	13:22:29.00	3.758	7.723
519	45.162	17.493	0.813	34.799	12.85	2339920	2481985	5/30/1998	13:28:29.80	3.917	7.721
520	45.135	17.474	0.769	34.793	12.851	2320630	2481709	5/30/1998	13:34:30.60	3.785	7.720
521	45.108	17.451	0.78	34.788	12.85	2338579	2481695	5/30/1998	13:40:31.40	3.908	7.720
522	45.085	17.417	0.789	34.798	12.851	2340791	2481806	5/30/1998	13:46:32.20	3.923	7.720
523	45.063	17.399	0.774	34.794	12.849	2338455	2481271	5/30/1998	13:52:33.00	3.907	7.718
524	45.043	17.381	0.796	34.793	12.85	2343934	2481408	5/30/1998	13:58:33.80	3.945	7.718
525	45.01	17.347	0.834	34.793	12.848	2324896	2482038	5/30/1998	14:04:34.60	3.814	7.721
526	44.972	17.313	0.861	34.79	12.848	2326023	2481267	5/30/1998	14:10:35.40	3.822	7.718
527	44.953	17.27	0.796	34.81	12.847	2349034	2481626	5/30/1998	14:16:36.20	3.980	7.719
528	44.901	17.236	0.847	34.794	12.847	2327044	2481361	5/30/1998	14:22:37.00	3.829	7.718
529	44.86	17.197	0.812	34.792	12.846	2291170	2481187	5/30/1998	14:28:37.80	3.583	7.717
530	44.829	17.152	0.797	34.804	12.844	2323168	2481856	5/30/1998	14:34:38.60	3.802	7.720
531	44.801	17.13	0.793	34.799	12.846	2316254	2481883	5/30/1998	14:40:39.40	3.755	7.720

Record No.	Conductivity (mS/cm)	Temperature (Deg. C)	Pressure (dBar)	Salinity (PSU)	CTD Bat. (Vdc)	D.O. (Integer)	pH (Integer)	Date	Time	D.O. (ml/L)	pH (Value)
532	44.788	17.111	0.79	34.804	12.846	2316198	2481208	5/30/1998	14:46:40.20	3.755	7.718
533	44.76	17.092	0.789	34.797	12.845	2328209	2480747	5/30/1998	14:52:41.00	3.837	7.716
534	44.723	17.059	0.761	34.792	12.843	2317699	2481637	5/30/1998	14:58:41.80	3.765	7.719
535	44.699	17.011	0.803	34.812	12.848	2338119	2480879	5/30/1998	15:04:42.60	3.905	7.716
536	44.661	16.977	0.737	34.809	12.846	2306482	2480838	5/30/1998	15:10:43.40	3.688	7.716
537	44.62	16.937	0.752	34.809	12.843	2335119	2481446	5/30/1998	15:16:44.20	3.884	7.719
538	44.589	16.908	0.706	34.806	12.841	2337976	2480970	5/30/1998	15:22:45.00	3.904	7.716
539	44.545	16.861	0.702	34.809	12.842	2326859	2480761	5/30/1998	15:28:45.80	3.828	7.716
540	44.522	16.833	0.71	34.813	12.841	2309443	2480819	5/30/1998	15:34:46.60	3.708	7.716
541	44.495	16.81	0.7	34.809	12.84	2308420	2480918	5/30/1998	15:40:47.40	3.701	7.716
542	44.465	16.785	0.68	34.804	12.84	2321747	2480805	5/30/1998	15:46:48.20	3.793	7.716
543	44.438	16.749	0.639	34.812	12.84	2325451	2481435	5/30/1998	15:52:49.00	3.818	7.718
544	44.415	16.717	0.648	34.82	12.843	2339895	2481379	5/30/1998	15:58:49.80	3.917	7.718
545	44.39	16.7	0.702	34.813	12.841	2310956	2481340	5/30/1998	16:04:50.60	3.719	7.718
546	44.365	16.675	0.667	34.813	12.839	2334141	2480805	5/30/1998	16:10:51.40	3.878	7.716
547	44.345	16.646	0.554	34.82	12.838	2345454	2481588	5/30/1998	16:16:52.20	3.955	7.719
548	44.321	16.628	0.616	34.815	12.838	2297626	2481229	5/30/1998	16:22:53.00	3.627	7.718
549	44.319	16.644	0.605	34.799	12.837	2300696	2481329	5/30/1998	16:28:53.80	3.648	7.718
550	44.339	16.647	0.628	34.814	12.844	2322034	2481895	5/30/1998	16:34:54.60	3.795	7.720
551	44.338	16.643	0.605	34.816	12.839	2328282	2481681	5/30/1998	16:40:55.40	3.837	7.720
552	44.328	16.634	0.553	34.815	12.84	2327137	2481625	5/30/1998	16:46:56.20	3.830	7.719
553	44.324	16.637	0.535	34.81	12.836	2297017	2482205	5/30/1998	16:52:57.00	3.623	7.722
554	44.333	16.645	0.54	34.811	12.837	2314413	2483107	5/30/1998	16:58:57.80	3.742	7.726
555	44.352	16.648	0.532	34.824	12.837	2320040	2482904	5/30/1998	17:04:58.60	3.781	7.725
556	44.365	16.663	0.505	34.823	12.837	2336185	2482267	5/30/1998	17:10:59.40	3.892	7.722
557	44.36	16.66	0.507	34.822	12.837	2319845	2483847	5/30/1998	17:17:00.20	3.780	7.729
558	44.371	16.687	0.504	34.807	12.837	2335070	2482923	5/30/1998	17:23:01.00	3.884	7.725
559	44.388	16.693	0.461	34.817	12.837	2309966	2483494	5/30/1998	17:29:01.80	3.712	7.727
560	44.408	16.709	0.504	34.821	12.837	2322082	2483483	5/30/1998	17:35:02.60	3.795	7.727
561	44.419	16.722	0.449	34.819	12.836	2327049	2483191	5/30/1998	17:41:03.40	3.829	7.726
562	44.423	16.737	0.424	34.81	12.836	2307450	2483219	5/30/1998	17:47:45.47	3.694	7.726
563	44.448	16.755	0.472	34.815	12.837	2316704	2483429	5/30/1998	17:53:46.27	3.758	7.727
564	44.467	16.776	0.439	34.814	12.837	2325010	2483311	5/30/1998	17:59:47.07	3.815	7.727
565	44.495	16.803	0.416	34.815	12.838	2313522	2483618	5/30/1998	18:05:47.87	3.736	7.728
566	44.517	16.829	0.412	34.812	12.838	2323538	2483754	5/30/1998	18:11:48.67	3.805	7.729
567	44.541	16.854	0.483	34.811	12.837	2331270	2483912	5/30/1998	18:17:49.47	3.858	7.729
568	44.573	16.885	0.424	34.812	12.838	2352604	2484172	5/30/1998	18:23:50.27	4.004	7.730
569	44.598	16.916	0.437	34.807	12.837	2313026	2483971	5/30/1998	18:29:51.07	3.733	7.729
570	44.634	16.943	0.357	34.815	12.836	2314830	2484002	5/30/1998	18:35:51.87	3.745	7.730
571	44.655	16.969	0.343	34.812	12.836	2316661	2483852	5/30/1998	18:41:52.67	3.758	7.729
572	44.682	16.991	0.411	34.816	12.838	2321050	2484249	5/30/1998	18:47:53.47	3.788	7.731
573	44.71	17.03	0.43	34.806	12.838	2305945	2484439	5/30/1998	18:53:54.27	3.684	7.731
574	44.734	17.052	0.379	34.808	12.838	2332542	2484144	5/30/1998	18:59:55.07	3.867	7.730
575	44.757	17.075	0.343	34.808	12.839	2332975	2484085	5/30/1998	19:05:55.87	3.870	7.730
576	44.769	17.084	0.357	34.811	12.836	2324107	2484439	5/30/1998	19:11:56.67	3.809	7.731
577	44.792	17.11	0.318	34.808	12.839	2331388	2484106	5/30/1998	19:17:57.47	3.859	7.730
578	44.81	17.127	0.313	34.809	12.839	2313910	2484145	5/30/1998	19:23:58.27	3.739	7.730
579	44.833	17.152	0.408	34.807	12.837	2328078	2484842	5/30/1998	19:29:59.07	3.836	7.733
580	44.855	17.171	0.355	34.811	12.838	2344090	2484449	5/30/1998	19:35:59.87	3.946	7.732
581	44.871	17.194	0.359	34.805	12.837	2339624	2484332	5/30/1998	19:42:00.67	3.915	7.731
582	44.888	17.21	0.38	34.805	12.837	2344343	2484705	5/30/1998	19:48:01.47	3.948	7.733
583	44.899	17.216	0.373	34.81	12.837	2310087	2484878	5/30/1998	19:54:02.27	3.713	7.733
584	44.904	17.222	0.337	34.809	12.839	2333516	2484756	5/30/1998	20:00:03.07	3.873	7.733
585	44.92	17.234	0.378	34.813	12.837	2316273	2485380	5/30/1998	20:06:03.87	3.755	7.736
586	44.93	17.252	0.355	34.806	12.837	2332862	2484519	5/30/1998	20:12:04.67	3.869	7.732
587	44.942	17.263	0.391	34.807	12.837	2304159	2484443	5/30/1998	20:18:05.47	3.672	7.731
588	44.949	17.269	0.347	34.808	12.838	2337755	2484307	5/30/1998	20:24:06.27	3.902	7.731
589	44.947	17.273	0.403	34.802	12.835	2324849	2484961	5/30/1998	20:30:07.07	3.814	7.734
590	44.957	17.286	0.375	34.8	12.837	2316579	2484758	5/30/1998	20:36:07.87	3.757	7.733
591	44.973	17.294	0.408	34.807	12.836	2340176	2484531	5/30/1998	20:42:08.67	3.919	7.732
592	44.974	17.294	0.409	34.807	12.836	2305631	2484242	5/30/1998	20:48:09.47	3.682	7.731
593	44.97	17.289	0.443	34.809	12.835	2350368	2484706	5/30/1998	20:54:10.27	3.989	7.733
594	44.978	17.31	0.368	34.797	12.835	2320151	2484715	5/30/1998	21:00:11.07	3.782	7.733
595	44.983	17.316	0.409	34.797	12.835	2374950	2484793	5/30/1998	21:06:11.87	4.158	7.733
596	44.992	17.316	0.498	34.805	12.835	2325091	2484815	5/30/1998	21:12:12.67	3.816	7.733
597	45	17.323	0.478	34.805	12.835	2330322	2484339	5/30/1998	21:18:13.47	3.851	7.731
598	44.999	17.321	0.49	34.806	12.835	2323568	2484905	5/30/1998	21:24:14.27	3.805	7.733
599	44.999	17.325	0.439	34.803	12.835	2312131	2484718	5/30/1998	21:30:15.07	3.727	7.733
600	44.999	17.325	0.504	34.803	12.833	2357488	2484551	5/30/1998	21:36:15.87	4.038	7.732
601	45.007	17.332	0.496	34.804	12.835	2356126	2484183	5/30/1998	21:42:16.67	4.029	7.730
602	45.008	17.336	0.5	34.8	12.834	2294992	2484451	5/30/1998	21:48:17.47	3.609	7.732
603	44.995	17.328	0.51	34.797	12.835	2344532	2484532	5/30/1998	21:54:18.27	3.949	7.732
604	44.995	17.318	0.464	34.805	12.833	2338993	2484706	5/30/1998	22:00:19.07	3.911	7.733
605	44.998	17.322	0.551	34.805	12.833	2336063	2484308	5/30/1998	22:06:19.87	3.891	7.731
606	44.988	17.324	0.485	34.794	12.833	2347245	2484718	5/30/1998	22:12:20.67	3.968	7.733
607	44.961	17.29	0.529	34.8	12.831	2327530	2484054	5/30/1998	22:18:21.47	3.832	7.730
608	44.942	17.261	0.601	34.809	12.831	2341420	2484308	5/30/1998	22:24:22.27	3.928	7.731
609	44.929	17.247	0.587	34.81	12.831	2320117	2484368	5/30/1998	22:30:23.07	3.781	7.731
610	44.897	17.211	0.624	34.813	12.832	2318803	2484852	5/30/1998	22:36:23.87	3.772	7.733
611	44.859	17.182	0.581	34.805	12.829	2300451	2484170	5/30/1998	22:42:24.67	3.646	7.730
612	44.842	17.159	0.673	34.81	12.829	2307613	2484224	5/30/1998	22:48:25.47	3.696	7.731
613	44.827	17.15	0.536	34.804	12.83	2342618	2484643	5/30/1998	22:54:26.27	3.936	7.732
614	44.815	17.131	0.656	34.811	12.83	2318363	2484742	5/30/1998	23:00:27.07	3.769	7.733
615	44.809	17.133	0.658	34.804	12.829	2327533	2484803	5/30/1998	23:06:27.87	3.832	7.733
616	44.78	17.102	0.651	34.805	12.828	2331690	2485428	5/30/1998	23:12:28.67	3.861	7.736
617	44.744	17.07	0.707	34.801	12.829	2302998	2484238	5/30/1998	23:18:29.47	3.664	7.731
618	44.72	17.046	0.725	34.801	12.827	2294114	2484737	5/30/1998	23:24:30.27	3.603	7.733
619	44.705	17.029	0.728	34.802	12.827	2331940	2484474	5/30/1998	23:30:31.07	3.863	7.732
620	44.684	16.994	0.73	34.814	12.827	2323665	2483807	5/30/1998	23:36:31.87	3.806	7.729
621	44.651	16.962	0.766	34.813	12.825	2307039	2483608	5/30/1998	23:42:32.67	3.692	7.728
622	44.628	16.949	0.732	34.804	12.825	2329842	2483527	5/30/1998	23:48:33.47	3.848	7.728
623	44.609	16.912	0.744	34.821	12.826	2310986	2484133	5/30/1998	23:54:34.27	3.719	7.730
624	44.583	16.889	0.662	34.817	12.826	2323973	2484025	5/31/1998	00:00:35.07	3.808	7.730
625	44.541	16.85	0.7	34.815	12.826	2314517	2483540	5/31/1998	00:06:35.87	3.743	7.728

Record No.	Conductivity (mS/cm)	Temperature (Deg. C)	Pressure (dBar)	Salinity (PSU)	CTD Bat. (Vdc)	D.O. (Integer)	pH (Integer)	Date	Time	D.O. (ml/L)	pH (Value)
626	44.514	16.81	0.718	34.826	12.825	2305950	2483341	5/31/1998	00:12:36.67	3.684	7.727
627	44.501	16.807	0.795	34.817	12.823	2318720	2484158	5/31/1998	00:18:37.47	3.772	7.730
628	44.482	16.791	0.716	34.814	12.823	2334235	2483380	5/31/1998	00:24:38.27	3.878	7.727
629	44.458	16.757	0.749	34.822	12.823	2303660	2482951	5/31/1998	00:30:39.07	3.668	7.725
630	44.449	16.762	0.773	34.81	12.823	2335158	2484032	5/31/1998	00:36:39.87	3.885	7.730
631	44.442	16.745	0.767	34.819	12.822	2317035	2483806	5/31/1998	00:42:40.67	3.760	7.729
632	44.411	16.72	0.716	34.814	12.822	2335917	2483119	5/31/1998	00:49:22.74	3.890	7.726
633	44.39	16.683	0.792	34.827	12.821	2300259	2483212	5/31/1998	00:55:23.54	3.645	7.726
634	44.382	16.683	0.748	34.819	12.821	2310443	2482885	5/31/1998	01:01:24.34	3.715	7.725
635	44.371	16.673	0.751	34.819	12.821	2310269	2483656	5/31/1998	01:07:25.14	3.714	7.728
636	44.357	16.656	0.692	34.822	12.82	2299976	2483270	5/31/1998	01:13:25.94	3.643	7.726
637	44.352	16.64	0.855	34.831	12.82	2303543	2483911	5/31/1998	01:19:26.74	3.668	7.729
638	44.35	16.65	0.689	34.821	12.819	2311595	2483846	5/31/1998	01:25:27.54	3.723	7.729
639	44.348	16.654	0.729	34.815	12.821	2286198	2482959	5/31/1998	01:31:28.34	3.549	7.725
640	44.335	16.644	0.741	34.813	12.819	2315982	2483572	5/31/1998	01:37:29.14	3.753	7.728
641	44.331	16.629	0.796	34.822	12.819	2308499	2483692	5/31/1998	01:43:29.94	3.702	7.728
642	44.32	16.607	0.786	34.833	12.819	2311654	2483279	5/31/1998	01:49:30.74	3.723	7.726
643	44.312	16.61	0.803	34.822	12.82	2323950	2484053	5/31/1998	01:55:31.54	3.808	7.730
644	44.299	16.592	0.811	34.826	12.819	2315010	2483069	5/31/1998	02:01:32.34	3.746	7.726
645	44.27	16.564	0.756	34.826	12.818	2325696	2482313	5/31/1998	02:07:33.14	3.820	7.722
646	44.238	16.531	0.67	34.826	12.818	2332486	2483377	5/31/1998	02:13:33.94	3.866	7.727
647	44.216	16.517	0.72	34.819	12.817	2304895	2483002	5/31/1998	02:19:34.74	3.677	7.725
648	44.201	16.497	0.666	34.822	12.819	2316913	2483223	5/31/1998	02:25:35.54	3.759	7.726
649	44.179	16.472	0.599	34.825	12.819	2300896	2483244	5/31/1998	02:31:36.34	3.649	7.726
650	44.164	16.461	0.591	34.822	12.818	2284959	2482831	5/31/1998	02:37:37.14	3.540	7.725
651	44.167	16.46	0.637	34.825	12.816	2300911	2482619	5/31/1998	02:43:37.94	3.650	7.724
652	44.166	16.459	0.65	34.825	12.816	2314387	2482802	5/31/1998	02:49:38.74	3.742	7.724
653	44.164	16.459	0.559	34.824	12.816	2299848	2482785	5/31/1998	02:55:39.54	3.642	7.724
654	44.177	16.45	0.539	34.843	12.817	2295863	2482534	5/31/1998	03:01:40.34	3.615	7.723
655	44.185	16.47	0.5	34.832	12.818	2295104	2484127	5/31/1998	03:07:41.14	3.610	7.730
656	44.19	16.487	0.563	34.822	12.815	2303198	2484003	5/31/1998	03:13:41.94	3.665	7.730
657	44.21	16.489	0.547	34.838	12.817	2302181	2484225	5/31/1998	03:19:42.74	3.658	7.731
658	44.218	16.519	0.514	34.818	12.815	2307547	2483527	5/31/1998	03:25:43.54	3.695	7.728
659	44.236	16.534	0.48	34.821	12.816	2302167	2483421	5/31/1998	03:31:44.34	3.658	7.727
660	44.252	16.544	0.422	34.826	12.816	2321940	2483373	5/31/1998	03:37:45.14	3.794	7.727
661	44.281	16.575	0.413	34.826	12.815	2286126	2483456	5/31/1998	03:43:45.94	3.548	7.727
662	44.302	16.603	0.435	34.82	12.818	2297277	2483741	5/31/1998	03:49:46.74	3.625	7.728
663	44.316	16.621	0.369	34.816	12.817	2301073	2483395	5/31/1998	03:55:47.54	3.651	7.727
664	44.336	16.631	0.395	34.825	12.816	2301366	2484162	5/31/1998	04:01:48.34	3.653	7.730
665	44.354	16.658	0.328	34.817	12.818	2308298	2483980	5/31/1998	04:07:49.14	3.700	7.729
666	44.386	16.676	0.344	34.83	12.817	2289449	2483188	5/31/1998	04:13:49.94	3.571	7.726
667	44.415	16.711	0.306	34.824	12.815	2293201	2483129	5/31/1998	04:19:50.74	3.597	7.726
668	44.441	16.736	0.275	34.827	12.816	2303105	2483821	5/31/1998	04:25:51.54	3.665	7.729
669	44.467	16.773	0.315	34.816	12.817	2327860	2483593	5/31/1998	04:31:52.34	3.835	7.728
670	44.492	16.797	0.179	34.818	12.817	2326132	2484109	5/31/1998	04:37:53.14	3.823	7.730
671	44.524	16.825	0.217	34.822	12.817	2306981	2483211	5/31/1998	04:43:53.94	3.691	7.726
672	44.56	16.865	0.18	34.819	12.816	2328597	2483898	5/31/1998	04:49:54.74	3.840	7.729
673	44.589	16.892	0.166	34.821	12.816	2336069	2483030	5/31/1998	04:55:55.54	3.891	7.725
674	44.618	16.924	0.098	34.818	12.816	2309710	2483795	5/31/1998	05:01:56.34	3.710	7.729
675	44.65	16.949	0.109	34.824	12.817	2302109	2483255	5/31/1998	05:07:57.14	3.658	7.726
676	44.68	16.986	0.072	34.818	12.817	2287068	2483245	5/31/1998	05:13:57.94	3.555	7.726
677	44.705	17.007	0.096	34.823	12.817	2315699	2483312	5/31/1998	05:19:58.74	3.751	7.727
678	44.73	17.034	0.003	34.82	12.817	2307496	2483303	5/31/1998	05:25:59.54	3.695	7.727
679	44.754	17.057	0.002	34.821	12.82	2322230	2483423	5/31/1998	05:32:00.34	3.796	7.727
680	44.765	17.066	-0.034	34.823	12.817	2343106	2482430	5/31/1998	05:38:01.14	3.939	7.723
681	44.79	17.107	-0.049	34.81	12.817	2322771	2482915	5/31/1998	05:44:01.94	3.800	7.725
682	44.822	17.131	-0.092	34.817	12.818	2297749	2483116	5/31/1998	05:50:02.74	3.628	7.726
683	44.843	17.156	-0.111	34.814	12.816	2326520	2482718	5/31/1998	05:56:03.54	3.825	7.724
684	44.874	17.183	-0.094	34.817	12.817	2324705	2482674	5/31/1998	06:02:04.34	3.813	7.724
685	44.901	17.221	-0.127	34.808	12.818	2329389	2482970	5/31/1998	06:08:05.14	3.845	7.725
686	44.934	17.248	-0.181	34.814	12.819	2350961	2482526	5/31/1998	06:14:05.94	3.993	7.723
687	44.963	17.282	-0.207	34.808	12.817	2322592	2483004	5/31/1998	06:20:06.74	3.798	7.725
688	44.994	17.31	-0.186	34.812	12.817	2327741	2483266	5/31/1998	06:26:07.54	3.834	7.726
689	45.028	17.349	-0.27	34.808	12.818	2311642	2482408	5/31/1998	06:32:08.34	3.723	7.723
690	45.059	17.375	-0.296	34.812	12.818	2328969	2482993	5/31/1998	06:38:09.14	3.842	7.725
691	45.098	17.409	-0.299	34.816	12.819	2312803	2482564	5/31/1998	06:44:09.94	3.731	7.723
692	45.122	17.431	-0.313	34.818	12.82	2323874	2481855	5/31/1998	06:50:10.74	3.807	7.720
693	45.155	17.474	-0.317	34.81	12.818	2315301	2482609	5/31/1998	06:56:11.54	3.748	7.724
694	45.188	17.509	-0.296	34.808	12.818	2300552	2482936	5/31/1998	07:02:12.34	3.647	7.725
695	45.217	17.534	-0.361	34.812	12.819	2316746	2481802	5/31/1998	07:08:13.14	3.758	7.720
696	45.245	17.565	-0.345	34.81	12.819	2339566	2483458	5/31/1998	07:14:13.94	3.915	7.727
697	45.281	17.605	-0.344	34.805	12.819	2328482	2481765	5/31/1998	07:20:14.74	3.839	7.720
698	45.318	17.649	-0.374	34.8	12.821	2341276	2481853	5/31/1998	07:26:15.54	3.927	7.720
699	45.342	17.67	-0.387	34.802	12.822	2331065	2481193	5/31/1998	07:32:16.34	3.857	7.717
700	45.354	17.68	-0.423	34.804	12.82	2343198	2481314	5/31/1998	07:38:17.14	3.940	7.718
701	45.376	17.705	-0.438	34.802	12.82	2342539	2481924	5/31/1998	07:44:17.94	3.935	7.721

BFSD 2 Triplicate Blank Tests - PAHs
Summary

PAH	Blank Flux ($ng/m^2/day$)			Repeatability ($ng/m^2/day$)		
	Test 1	Test 2	Test 3	Average Flux	+/- 95% C.L.	Std. Deviation
1. Naphthalene	-243.5	-448.1	-629.3	-440	218.4	193.0
2. Acenaphthene	-32.4	ND	ND	-32.4	n/a	n/a
3. Acenaphthylene	-350.2	141.0	275.9	22.2	372.9	329.5
4. Fluorene	125.5	-69.3	-84.2	-9	132.4	117.0
5. Phenanthrene	89.0	-39.8	-16.3	11	77.6	68.6
6. Anthracene	182.3	53.1	-324.8	-30	298	263
7. Fluoranthene	-421.5	-1539.0	-1308.9	-1089.8	667.8	590.1
8. Pyrene	76.6	-447.1	-431.9	-267.5	337.3	298.0
9. Benzo(a)anthracene	ND	ND	ND	n/a	n/a	n/a
10. Chrysene	23.9	-61.9	ND	-19.0	84.2	60.7
11. Benzo(b)fluoranthene	ND	ND	-134.3	-134.3	n/a	n/a
12. Benzo(k)fluoranthene	ND	ND	-9.8	-9.8	n/a	n/a
13. Benzo(a)pyrene	ND	ND	ND	n/a	n/a	n/a
14.Indeno(1,2,3-c,d)pyrene	ND	ND	ND	n/a	n/a	n/a
15. Dibenz(a,h)anthracene	ND	ND	ND	n/a	n/a	n/a
16. Benzo(g,h,I)perylene	ND	19.6	ND	19.6	n/a	n/a

BFSD 2 Triplicate Blank Tests - PCBs
Summary

PCB	Blank Flux ($ng/m^2/day$)			Repeatability ($ng/m^2/day$)		
	Test 1	Test 2	Test 3	Average Flux	+/- 95% C.L.	Std. Deviation
(8) 2,4'-Dichlorobiphenyl	-66.6	ND	47.8	-9.4	112.2	80.9
(18) 2,2',5-Trichlorobiphenyl	205.2	23.3	27.0	85.2	117.6	104.0
(28) 2,4,4'-Trichlorobiphenyl	-8.0	ND	ND	-8.0	n/a	n/a
(52) 2,2',5,5'-Tetrachlorobiphenyl	ND	7.9	89.9	49	80.4	58.0
(66) 2,3',4,4'-Tetrachlorobiphenyl	53.6	16.6	ND	35	36.2	26.2
(101) 2,2',4,5,5'-Pentachlorobiphenyl	57.8	57.4	-3.5	37	40	35
(118) 2,3',4,4',5-Pentachlorobiphenyl	ND	2.7	2.3	2.5	0.3	0.2
(153) 2,2',4,4',5,5'-Hexachlorobiphenyl	ND	ND	9.5	9.5	n/a	n/a
(180) 2,2',3,4,4',5,5'-Heptachlorobiphenyl	ND	-9.6	ND	-9.6	n/a	n/a
(206) 2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl	-2.8	247.0	-17.0	75.7	168.0	148.5
(209) 2,2',3,3',4,4',5,5',6,6'-Decachlorobiphenyl	-18.5	ND	ND	-18.5	n/a	n/a

BFSD 2 Triplicate Blank Tests - Pesticides Summary

Pesticide	Blank Flux ($ng/m^2/day$)			Repeatability ($ng/m^2/day$)		
	Test 1	Test 2	Test 3	Average Flux	+/- 95% C.L.	Std. Deviation
alpha-Chlordane	7.0	ND	ND	7.0	n/a	n/a
2,4'-DDD	7.0	ND	ND	7.0	n/a	n/a
Methoxychlor	25.7	ND	ND	25.7	n/a	n/a
Endosulfan I	48.8	ND	ND	48.8	n/a	n/a
hexachlorobutadiene	ND	ND	22.0	22.0	n/a	n/a
Heptachlor	304.5	ND	ND	304.5	n/a	n/a
Heptachlor Epoxide	ND	ND	8.8	8.8	n/a	n/a
alpha-hexachlorocyclohexane	3.3	ND	ND	3.3	n/a	n/a
beta-hexachlorocyclohexane	61.0	ND	ND	61.0	n/a	n/a
lindane	35.2	132.3	33.8	67.1	63.9	56.5
trans-Nonachlor	40.8	ND	ND	40.8	n/a	n/a

BFSD 2
Paleta Creek Demonstration Summary

Metal	Flux ($\mu g/m^2/day$)	+/- 95% C.L. ($\mu g/m^2/day$)	Flux rate Confidence (%)	Triplicate Blank Flux ($\mu g/m^2/day$) Average	Triplicate Blank Flux ($\mu g/m^2/day$) +/- 95% C.L.	Bulk Sediment ($\mu g/g$)	Overlying Water ($\mu g/L$)
Copper (Cu)	-6.57	17.74	80.7%	2.82	8.73	165	1.46
Cadmium (Cd)	7.02	3.87	100.0%	-0.52	0.75	1.16	0.06897
Lead (Pb)	4.32	12.39	65.6%	3.16	1.59	98.9	0.07879
Nickel (Ni)	19.44	8.75	99.8%	10.28	7.34	19.1	0.8378
Manganese (Mn)	103.94	957.14	73.3%	-264.85	7.49	405	24.02
Manganese (Mn)[1]	4194.24	101841.76	99.9%	-264.85	7.49	405	24.02
Zinc (Zn)	574.26	274.14	100%	-3.38	-68.61	356	8.38

Other							
Oxygen (O_2)* (*$ml/m^2/day$)	-1341.12	160.18	na	na	na	na	4.7
Silica (SiO_2)* (*$mg/m^2/day$)	28.75	15.63	100%	-1.97	2.88	na	0.79

1. Mn flux calculated on the basis of first three samples due to non-linearity

BFSD 2
Paleta Creek Pre-Demo Summary

Metal	Flux ($\mu g/m^2/day$)	+/- 95% C.L. ($\mu g/m^2/day$)	Flux rate Confidence (%)	Triplicate Blank Flux ($\mu g/m^2/day$) Average	Triplicate Blank Flux +/- 95% C.L.	Bulk Sediment ($\mu g/g$)	Overlying Water ($\mu g/L$)
Copper (Cu)	-1.75	19.71	38.1%	2.82	8.73	165	1.54
Cadmium (Cd)	9.64	4.14	100.0%	-0.52	0.75	1.16	0.148
Lead (Pb)	11.06	7.94	100.0%	3.16	1.59	98.9	0.1561
Nickel (Ni)	25.24	4.62	100.0%	10.28	7.34	19.1	0.9262
Manganese (Mn)	71.33	701.54	80.7%	-264.85	7.49	405	28.12
Manganese (Mn)[1]	5763.99	23621.84	100.0%	-264.85	7.49	405	28.12
Zinc (Zn)	715.02	257.38	100.0%	-3.38	65.22	356	8.90

Other							
Oxygen (O_2)* (*$ml/m^2/day$)	-1050.87	86.25	na	na	na	na	5.2
Silica (SiO_2)* (*$mg/m^2/day$)	30.29	11.33	100%	-1.97	2.88	na	0.81

1. Mn flux calculated on the basis of first three samples due to non-linearity

BFSD 2
Pearl Harbor Bishop Point Site Summary

Metal	Flux ($\mu g/m^2/day$)	+/- 95% C.L. ($\mu g/m^2/day$)	Flux rate Confidence (%)	Triplicate Blank Flux ($\mu g/m^2/day$) Average	Triplicate Blank Flux ($\mu g/m^2/day$) +/- 95% C.L.	Bulk Sediment ($\mu g/g$)	Overlying Water ($\mu g/L$)
Copper (Cu)	112.46	17.60	100.0%	2.82	8.73	241	0.36
Cadmium (Cd)	1.85	1.96	99.4%	-0.52	0.75	0.3	0.009
Lead (Pb)	0.71	1.11	78.7%	3.16	1.59	93	0.06519
Nickel (Ni)	21.04	15.41	96.3%	10.28	7.34	42.9	0.3934
Manganese (Mn)	223.33	284.79	100.0%	-264.85	7.49	324	1.78
Manganese (Mn)[1]	2177.45	192.60	100.0%	-264.85	7.49	324	1.78
Zinc (Zn)	191.18	54.07	100.0%	-3.38	65.22	304	1.43

Other							
Oxygen (O_2)* (*ml/m^2/day)	-567.12	54.96	na	na	na	na	6.5
Silica (SiO_2)* (*mg/m^2/day)	118.61	27.62	100%	-1.97	2.88	na	0.31

1. Mn flux calculated on the basis of first three samples due to non-linearity

BFSD 2
Pearl Harbor Middle Loch Summary

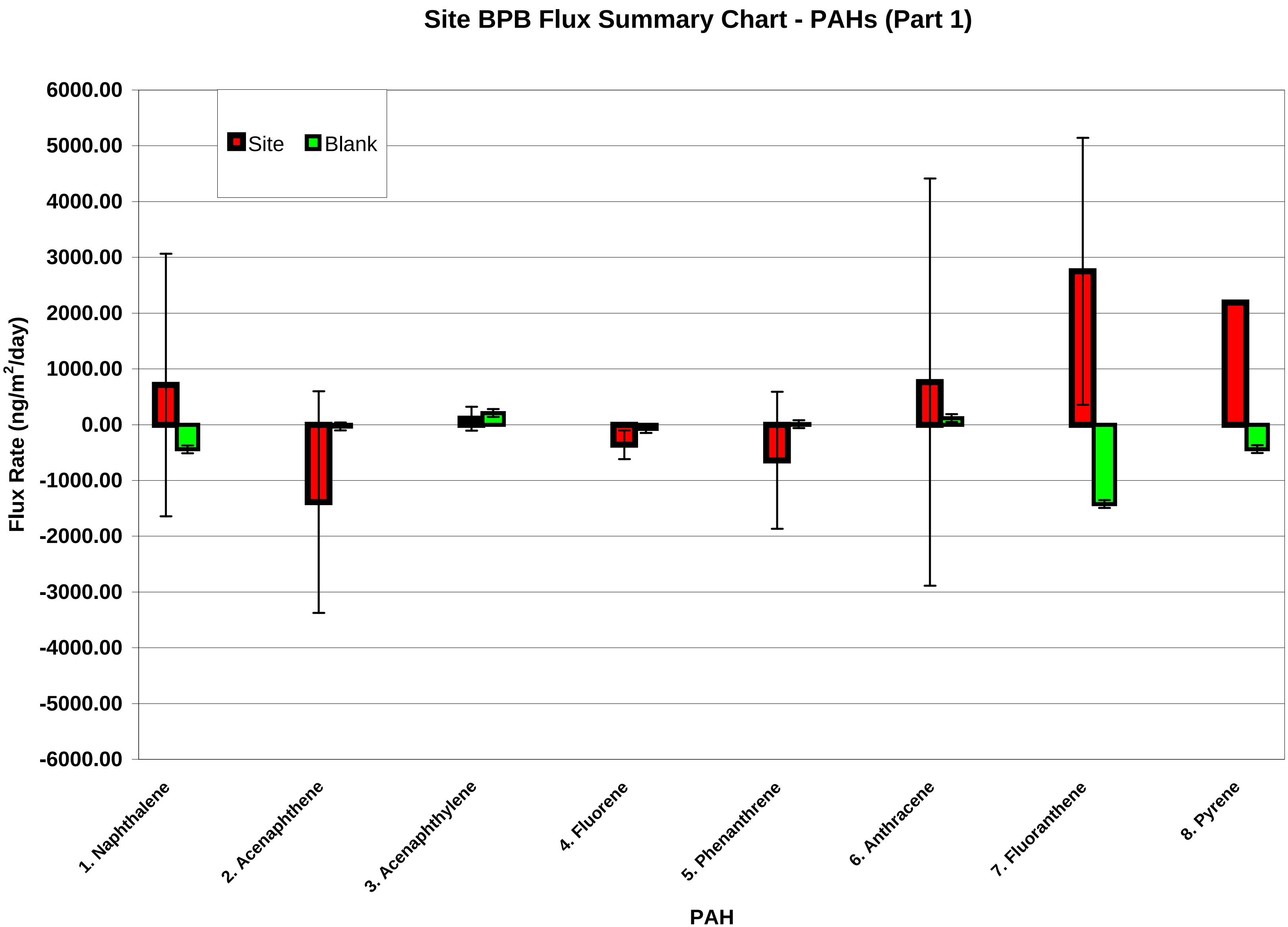
Metal	Flux ($\mu g/m^2/day$)	+/- 95% C.L. ($\mu g/m^2/day$)	Flux rate Confidence (%)	Triplicate Blank Flux ($\mu g/m^2/day$) Average	Triplicate Blank Flux +/- 95% C.L.	Bulk Sediment ($\mu g/g$)	Overlying Water ($\mu g/L$)
Copper (Cu)	14.79	3.46	99.9%	2.82	8.73	195	0.80
Cadmium (Cd)	1.80	0.31	100.0%	-0.52	0.75	0.2	0.02277
Lead (Pb)	-0.12	0.43	95.2%	3.16	1.59	34	0.03879
Nickel (Ni)	27.17	15.91	100.0%	10.28	7.34	214	0.9472
Manganese (Mn)	-468.18	683.35	97.9%	-264.85	7.49	1180	52.19
Manganese (Mn)[1]	2131.59	904.57	100.0%	-264.85	7.49	1180	52.19
Zinc (Zn)	49.74	17.25	93.5%	-3.38	65.22	314	2.28
Other							
Oxygen (O_2)* (*$ml/m^2/day$)	-1085.52	64.84	na	na	na	na	4.17
Silica (SiO_2)* (*$mg/m^2/day$)	65.03	42.43	100%	-1.97	2.88	na	1.19

1. Mn flux calculated on the basis of first five samples due to non-linearity

BFSD 2 12/9/2002
BPB Site Summary

Metal	Flux ($\mu g/m^2/day$)*	+/- 95% C.L. ($\mu g/m^2/day$)	Flux rate Confidence (%)	Triplicate Blank Flux ($\mu g/m^2/day$) Average	Triplicate Blank Flux +/- 95% C.L.	Bulk Sediment ($\mu g/g$)	Overlying Water ($\mu g/L$)
Arsenic (As)	23.48	6.94	100%	-5.16	2.10		
Copper (Cu)	-71.30	39.43	100.0%	2.82	8.73		
Cadmium (Cd)	1.31	1.63	98.1%	-0.52	0.75		
Lead (Pb)	17.40	24.63	99.0%	3.16	1.59		
Nickel (Ni)	59.18	55.96	100.0%	10.28	7.34		
Manganese (Mn)	427.65	238.42	100.0%	-264.85	7.49		
Manganese (Mn)[1]	1940.13	3853.41	100.0%	-264.85	7.49		
Silver (Ag)	-0.36	0.88	86.1%	0.64	0.68		
Zinc (Zn)	374.36	133.74	100.0%	-3.38	65.22		
Other							
Oxygen (O_2)* (*$ml/m^2/day$)	-1457.09	48.92	na	na	na		
Silica (SiO_2)* (*$mg/m^2/day$)	0.00	0.00	48%	-1.97	2.88		

1. Mn flux calculated on the first three samples due to non-linearity and to compare with metals-only demonstration


Site BPB Flux Summary Chart - PAHs (Part 1)
Site
Blank
6000.00
5000.00
4000.00
3000.00
2000.00
1000.00
0.00
-1000.00
-2000.00
-3000.00
-4000.00
-5000.00
-6000.00
Flux Rate (ng/m2/day)
1. Naphthalene
2. Acenaphthene
3. Acenaphthylene
4. Fluorene
5. Phenanthrene
6. Anthracene
7. Fluoranthene
8. Pyrene
PAH

BFSD 2 - 12/9/2003
BPB Site Summary- PAHs (Part 2)

PAH	Flux	+/- 95% C.L.	Flux rate Confidence	Triplicate Blank Flux (ng/m²/day)		Bulk Sediment	Overlying Water
	(ng/m²/day)*	(ng/m²/day)	(%)	Average	+/- 95% C.L.	(ng/g)	(ng/L)
9. BENZO(A)ANTHRACENE	152.67	140.49	NA	NA	NA		
10. CHRYSENE	286.65	341.92	94.7%	23.94	22.32		
11. BENZO(B)FLUORANTHENE	561.07	376.08	97.9%	-134.30	297.91		
12. BENZO(K)FLUORANTHENE	452.24	465.75	82.8%	-9.71	36.30		
13. BENZO(A)PYRENE	383.46	603.38	NA	NA	NA		
14. INDENO(1,2,3-C,D)PYRENE	8.68	10.98	NA	NA	NA		
15. DIBENZ(A,H)ANTHRACENE	-1.97	7.69	NA	NA	NA		
16. BENZO(G,H,I)PERYLENE	8.77	10.59	12.9%	20.15	65.15		

BFSD 2
BPB Site Summary- PAHs (Part 1)

PAH	Flux (ng/m²/day)*	+/- 95% C.L. (ng/m²/day)	Flux Rate Confidence (%)	Triplicate Blank Flux (ng/m²/day) Average	+/- 95% C.L.	Bulk Sediment (ng/g)	Overlying Water (ng/L)
1. Naphthalene	2456.72	13211.62	100.0%	-440.30	458.38		
2. Acenaphthene	9222.27	6867.34	100.0%	-32.40	50.34		
3. Acenaphthylene	778.37	880.29	100.0%	208.47	112.60		
4. Fluorene	285.70	2021.66	100.0%	-76.74	28.38		
5. Phenanthrene	-3555.98	7892.27	100.0%	10.95	10.95		
6. Anthracene	2874.10	1330.22	100.0%	117.68	64.62		
7. Fluoranthene	19696.65	3869.67	100.0%	-1423.95	178.41		
8. Pyrene	12101.21	3884.64	100.0%	-439.51	70.73		

Other
(See Metals Analysis in combined deployments for these data)

Oxygen (O_2)* (*ml/m²/day)	0.00	0.00	na	na	na		
Silica (SiO_2)* (*mg/m²/day)	0.00	0.00	48%	-1.97	2.88		

BFSD 2 - Site BPB (12/9/2002) - PAHs (Part 2)

First 4 samples only

Site: Site BPB (21 19.815 N X 157 58.000W)
Date: 12/9/2003

Start time:
Interval: 7 hr
End time:

Bottle Volume =	0.25	liters
Chamber Volume =	30	liters
Chamber Area =	1701.4	cm^2

Sample id	BFSD 2 Data: Measured Concentration (pptr)**	Sample No.*	Elapsed Time (hrs)	Dilution Correction: Measured Concentration (pptr)**	Corrected Concentration (pptr)**	# of Dilutions	Intercept Corrected Concentration (pptr)	From Regression Concentration (pptr)**	Lower 95% Conf. Int.	Upper 95% Conf. Int.
BENZO(A)ANTHRACENE										
BFSD2-BPB-1	2.72	T-#0	0	2.720		n/a				
BFSD2-BPB-2	4.50	#1	0.3	4.500	4.5000	0	0.237	0.054	-2.783	2.891
BFSD2-BPB-3	5.62	#2	7.3	5.620	5.6348	1	1.371	1.313	-1.524	4.149
BFSD2-BPB-4	6.13	#3	14.3	6.130	6.1690	2	1.906	2.571	-0.266	5.408
BFSD2-BPB-5	8.45	#4	21.3	8.450	8.5174	3	4.254	3.830	0.993	6.667
BFSD2-BPB-6	6.77	#5	28.3	6.770	6.8852	4	2.622	5.089	2.252	7.925
BFSD2-BPB-7	6.99	#6	35.3	6.990	7.1389	5	2.876	6.347	3.510	9.184
BFSD2-BPB-8	7.56	#7	42.3	7.560	7.745	6	3.481	7.606	4.769	10.443
BFSD2-BPB-10	6.51	#9	56.3	6.510	6.9162	8	2.653	10.123	7.286	12.960
BFSD2-BPB-11	8.43	#10	63.3	8.430	8.8904	9	4.627	11.382	8.545	14.219
BFSD2-BPB-12	6.70	#11	70.3	6.700	7.2307	10	2.967	12.640	9.803	15.477

Flux Statistics		Blank Statistics	
slope=	0.1798	slope=	#REF!
intercept=	4.2634		
St. Err of Slope=	0.0367		
St Err of Int=	0.4894		
R2=	0.9231		
St Err of Y=	0.5744	St Err of Y=	#REF!
F=	24.01044943		
DF=	2	DF=	#REF!
RegSS=	7.920894225		
ResSS=	0.659787252	ResSS=	#REF!
Sumx2=	16666.5	Sumx2=	#REF!
Average Conc.	6.474		
Initial Conc	4.500		

Comparitive Statistics

$S^2_{(y-x)}$ =	#REF!
$S_{(b1-b2)}$ =	#REF!
t =	#REF!
p =	#REF!

Final Results

Flux =	**760.90**	**$ng/m^2/day$**
95% CI (low) =	**92.77**	**$ng/m^2/day$**
95% CI (high) =	**1429.04**	**$ng/m^2/day$**
% Conf (dif from blank)=	**#REF!**	
Blank Flux=	**−134.29613**	**$ng/m^2/day$**
95% CI (low) =	**−432.20593**	**$ng/m^2/day$**
95% CI (high) =	**163.613683**	**$ng/m^2/day$**

LINEST statistics

0.1798	4.2634
0.0367	0.4894
0.9231	0.5744
24.01044943	2
7.920894225	0.659787252

Notes

Sample id	BFSD 2 Data: Measured Concentration (pptr)**	Sample No.*	Elapsed Time (hrs)	Dilution Correction: Measured Concentration (pptr)**	Corrected Concentration (pptr)**	# of Dilutions	Intercept Corrected Concentration (pptr)	From Regression Concentration (pptr)**	Lower 95% Conf. Int.	Upper 95% Conf. Int.
CHRYSENE										
BFSD2-BPB-1	1.18	T-#0	0	1.180		n/a				
BFSD2-BPB-2	7.90	#1	0.3	7.900	7.9000	0	0.797	0.138	-5.671	5.947
BFSD2-BPB-3	10.0	#2	7.3	10.000	10.0560	1	2.953	3.362	-2.447	9.171
BFSD2-BPB-4	12.4	#3	14.3	12.400	12.5295	2	5.427	6.587	0.778	12.396
BFSD2-BPB-5	17.6	#4	21.3	17.600	17.8230	3	10.720	9.811	4.002	15.620
BFSD2-BPB-6	11.5	#5	28.3	11.500	11.8598	4	4.757	13.035	7.226	18.844
BFSD2-BPB-7	12.8	#6	35.3	12.800	13.2458	5	6.143	16.259	10.450	22.068
BFSD2-BPB-8	13.2	#7	42.3	13.200	13.743	6	6.640	19.484	13.675	25.293
BFSD2-BPB-9	11	#8	49.3	10.500	11.1428	7	4.040	22.708	16.899	28.517
BFSD2-BPB-10	16.4	#9	56.3	16.400	17.1205	8	10.018	25.932	20.123	31.741
BFSD2-BPB-11	14.6	#10	63.3	14.600	15.4473	9	8.345	29.156	23.347	34.965
BFSD2-BPB-12	12.6	#11	70.3	12.600	13.5592	10	6.457	32.381	26.572	38.190

Flux Statistics		Blank Statistics	
slope=	0.4606	slope=	0.003950364
intercept=	7.1026		
St. Err of Slope=	0.0752		
St Err of Int=	1.0035		
R2=	0.9493		
St Err of Y=	1.1777	St Err of Y=	0.003681693
F=	37.47442787		
DF=	2	DF=	7
RegSS=	51.97894031		
ResSS=	2.774101875	ResSS=	0.511425087
Sumx2=	19096.99	Sumx2=	5390
Average Conc.	12.034		
Initial Conc	7.900		

Comparitive Statistics

$S^2_{(y-x)}$ =	0.365058551
$S_{(b1-b2)}$ =	0.00931906
t =	49.00244917
p =	3.07797E-12

Final Results

Flux =	**1949.20**	**$\mu g/m^2/day$**
95% CI (low) =	**579.19**	**$\mu g/m^2/day$**
95% CI (high) =	**3319.22**	**$\mu g/m^2/day$**
% Conf (dif from blank)=	**100%**	
Blank Flux=	**−9.710954**	**$\mu g/m^2/day$**
95% CI (low) =	**−46.008488**	**$\mu g/m^2/day$**
95% CI (high) =	**26.5865797**	**$\mu g/m^2/day$**

LINEST statistics

0.4606	7.1026
0.0752	1.0035
0.9493	1.1777
37.47442787	2
51.97894031	2.774101875

Notes

Sample id	BFSD 2 Data: Measured Concentration (pptr)**	Sample No.*	Elapsed Time (hrs)	Dilution Correction: Measured Concentration (pptr)**	Corrected Concentration (pptr)**	# of Dilutions	Intercept Corrected Concentration (pptr)	From Regression Concentration (pptr)**	Lower 95% Conf. Int.	Upper 95% Conf. Int.
BENZO(B)FLUORANTHENE										
BFSD2-BPB-1	2.32	T-#0	0	2.320		n/a				
BFSD2-BPB-2	8.99	#1	0.3	8.990	8.9900	0	0.706	0.133	-12.291	12.558
BFSD2-BPB-3	9.32	#2	7.3	9.320	9.3756	1	1.092	3.241	-9.183	15.665
BFSD2-BPB-4	17.1	#3	14.3	17.100	17.2139	2	8.930	6.349	-6.075	18.773
BFSD2-BPB-5	16.5	#4	21.3	16.500	16.7371	3	8.453	9.457	-2.967	21.881
BFSD2-BPB-6	16.3	#5	28.3	16.300	16.6553	4	8.371	12.565	0.141	24.989
BFSD2-BPB-7	14.8	#6	35.3	14.800	15.2718	5	6.988	15.673	3.249	28.097
BFSD2-BPB-8	18.4	#7	42.3	18.400	18.976	6	10.692	18.781	6.357	31.205
BFSD2-BPB-11	18.7	#10	63.3	18.700	19.5644	9	11.280	28.105	15.680	40.529
BFSD2-BPB-12	18.1	#11	70.3	18.100	19.1203	10	10.836	31.213	18.788	43.637

Flux Statistics		Blank Statistics	
slope=	0.4440	slope=	-0.0221561
intercept=	8.2840		
St. Err of Slope=	0.1605		
St Err of Int=	2.1402		
R2=	0.7929		
St Err of Y=	2.5117	St Err of Y=	0.049148994
F=	7.655682812		
DF=	2	DF=	4
RegSS=	48.29702501		
ResSS=	12.61730043	ResSS=	19.88541378
Sumx2=	13496.81	Sumx2=	2058
Average Conc.	13.794		
Initial Conc	8.990		

Comparitive Statistics

$S^2_{(y-x)}$ =	5.417119035
$S_{(b1-b2)}$ =	0.055078017
t =	8.463451966
p =	0.00014867

Final Results

Flux =	**1878.90**	**$\mu g/m^2/day$**
95% CI (low) =	**-1042.88**	**$\mu g/m^2/day$**
95% CI (high) =	**4800.68**	**$\mu g/m^2/day$**
% Conf (dif from blank)=	**100%**	
Blank Flux=	**#PEΦ!**	**$\mu g/m^2/day$**
95% CI (low) =	**#PEΦ!**	**$\mu g/m^2/day$**
95% CI (high) =	**#PEΦ!**	**$\mu g/m^2/day$**

LINEST statistics

0.4440	8.2840
0.1605	2.1402
0.7929	2.5117
7.655682812	2
48.29702501	12.61730043

Notes

Sample id	BFSD 2 Data: Measured Concentration (pptr)**	Sample No.*	Elapsed Time (hrs)	Dilution Correction: Measured Concentration (pptr)**	Corrected Concentration (pptr)**	# of Dilutions	Intercept Corrected Concentration (pptr)	From Regression Concentration (pptr)**	Lower 95% Conf. Int.	Upper 95% Conf. Int.
BENZO(K)FLUORANTHENE										
BFSD2-BPB-1	2.62	T-#0	0	2.620		n/a				
BFSD2-BPB-2	7.42	#1	0.3	7.420	7.4200	0	0.951	0.134	-6.356	6.624
BFSD2-BPB-3	8.15	#2	7.3	8.150	8.1900	1	1.721	3.260	-3.230	9.751
BFSD2-BPB-4	13.4	#3	14.3	13.400	13.4861	2	7.017	6.387	-0.104	12.877
BFSD2-BPB-5	15.9	#4	21.3	15.900	16.0759	3	9.606	9.513	3.023	16.004
BFSD2-BPB-6	10.9	#5	28.3	10.900	11.1866	4	4.717	12.640	6.149	19.130
BFSD2-BPB-7	12.9	#6	35.3	12.900	13.2556	5	6.786	15.766	9.275	22.256
BFSD2-BPB-8	17.9	#7	42.3	17.900	18.341	6	11.872	18.892	12.402	25.383
BFSD2-BPB-11	17.5	#10	63.3	17.500	18.2433	9	11.774	28.271	21.781	34.762
BFSD2-BPB-12	12.4	#11	70.3	12.400	13.2891	10	6.820	31.398	24.907	37.888

Flux Statistics		Blank Statistics	
slope=	0.4466	slope=	-0.001602108
intercept=	6.4694		
St. Err of Slope=	0.0838		
St Err of Int=	1.1181		
R2=	0.9342		
St Err of Y=	1.3121	St Err of Y=	0.005988347
F=	28.3865123		
DF=	2	DF=	2
RegSS=	48.87136373		
ResSS=	3.443280613	ResSS=	0.117143642
Sumx2=	13496.81	Sumx2=	1633.333333
Average Conc.	11.272		
Initial Conc	7.420		

Comparitive Statistics

$S^2_{(y-x)}$ =	0.890106064
$S_{(b1-b2)}$ =	0.024716639
t =	18.13467808
p =	5.43699E-05

Final Results

Flux =	**1890.04**	**$\mu g/m^2/day$**
95% CI (low) =	**363.70**	**$\mu g/m^2/day$**
95% CI (high) =	**3416.37**	**$\mu g/m^2/day$**
% Conf (dif from blank)=	**100%**	
Blank Flux=	**#PEΦ!**	**$\mu g/m^2/day$**
95% CI (low) =	**#PEΦ!**	**$\mu g/m^2/day$**
95% CI (high) =	**#PEΦ!**	**$\mu g/m^2/day$**

LINEST statistics

0.4466	6.4694
0.0838	1.1181
0.9342	1.3121
28.3865123	2
48.87136373	3.443280613

Notes

BFSD2-SPL-10-1
BFSD2-SPL-10-2
BFSD2-SPL-10-3
BFSD2-SPL-10-4
BFSD2-SPL-10-5
BFSD2-SPL-10-6
BFSD2-SPL-10-7
BFSD2-SPL-10-8
BFSD2-SPL-10-9
BFSD2-SPL-10-10
BFSD2-SPL-10-11

BFSD2
BPB Site - 12/9/2002
PAH Flux Analysis

Bottle Volume =	0.25	liters
Chamber Volume =	30	liters
Chamber Area =	1701.4	cm^2

BENZO(A)PYRENE

Sample id	BFSD 2 Data: Measured Concentration (pptr)**	Sample No.*	Elapsed Time (hrs)	Dilution Correction: Measured Concentration (pptr)**	Corrected Concentration (pptr)**	# of Dilutions	Intercept Corrected Concentration (pptr)	From Regression Concentration (pptr)**	Lower 95% Conf. Int.	Upper 95% Conf. Int.
BFSD2-BPB-1	2.00	T-#0	0	2.000		n/a				
BFSD2-BPB-2	2.00	#1	0.3	2.000	2.0000	0	0.794	0.100	-7.469	7.669
BFSD2-BPB-3	2.00	#2	7.3	2.000	2.0000	1	0.794	2.438	-5.131	10.007
BFSD2-BPB-4	7.19	#3	14.3	7.190	7.1900	2	5.984	4.776	-2.793	12.345
BFSD2-BPB-5	8.02	#4	21.3	8.020	8.0633	3	6.857	7.114	-0.455	14.683
BFSD2-BPB-6	2.00	#5	28.3	2.000	2.0934	4	0.887	9.452	1.883	17.021
BFSD2-BPB-7	6.23	#6	35.3	6.230	6.3234	5	5.117	11.790	4.221	19.359
BFSD2-BPB-8	7.16	#7	42.3	7.160	7.289	6	6.083	14.128	6.559	21.697
BFSD2-BPB-9	18.3	#8	49.3	18.300	18.4717	7	17.266	16.466	8.897	24.035
BFSD2-BPB-10	2.00	#9	56.3	2.000	2.3075	8	1.101	18.804	11.235	26.373
BFSD2-BPB-11	9.68	#10	63.3	9.680	9.9875	9	8.781	21.142	13.573	28.711
BFSD2-BPB-12	6.92	#11	70.3	6.920	7.2915	10	6.085	23.480	15.911	31.049

Flux Statistics		Blank Statistics	
slope=	0.3340	slope=	#REF!
intercept=	1.2062		
St. Err of Slope=	0.0980		
St Err of Int=	1.3076		
R2=	0.8530		
St Err of Y=	1.5345	St Err of Y=	#REF!
F=	11.60645909		
DF=	2	DF=	#REF!
RegSS=	27.3306355		
ResSS=	4.709556169	ResSS=	#REF!
Sumx2=	19096.99	Sumx2=	#REF!
Average Conc.	4.269		
Initial Conc	2.000		

Comparitive Statistics

$S^2_{(y-x)}$ =	#REF!
$S_{(b1-b2)}$ =	#REF!
t =	#REF!
p =	#REF!

Final Results

Flux =	**1413.41**	$\mu g/m^2/day$
95% CI (low) =	**-371.66**	$\mu g/m^2/day$
95% CI (high) =	**3198.48**	$\mu g/m^2/day$
% Conf (dif from blank)=	**#REF!**	
Blank Flux=	**#РЕФ!**	$\mu g/m^2/day$
95% CI (low) =	**#РЕФ!**	$\mu g/m^2/day$
95% CI (high) =	**#РЕФ!**	$\mu g/m^2/day$

LINEST statistics

0.3340	1.2062
0.0980	1.3076
0.8530	1.5345
11.60645909	2
27.3306355	4.709556169

Notes

INDENO(1,2,3-C,D)PYRENE

Sample id	BFSD 2 Data: Measured Concentration (pptr)**	Sample No.*	Elapsed Time (hrs)	Dilution Correction: Measured Concentration (pptr)**	Corrected Concentration (pptr)**	# of Dilutions	Intercept Corrected Concentration (pptr)	From Regression Concentration (pptr)**	Lower 95% Conf. Int.	Upper 95% Conf. Int.
BFSD2-BPB-1	1.98	T-#0	0	1.98		n/a				
BFSD2-BPB-2	1.98	#1	0.3	1.98	1.9800	0	0.049	0.003	-0.437	0.443
BFSD2-BPB-3	1.98	#2	7.3	1.98	1.9800	1	0.049	0.072	-0.368	0.512
BFSD2-BPB-4	1.98	#3	14.3	1.98	1.9800	2	0.049	0.141	-0.299	0.581
BFSD2-BPB-5	2.21	#4	21.3	2.21	2.2100	3	0.279	0.210	-0.230	0.650
BFSD2-BPB-6	1.98	#5	28.3	1.98	1.9819	4	0.051	0.279	-0.161	0.719
BFSD2-BPB-7	1.98	#6	35.3	1.98	1.9819	5	0.051	0.348	-0.092	0.788
BFSD2-BPB-8	1.98	#7	42.3	1.980	1.982	6	0.051	0.417	-0.023	0.857
BFSD2-BPB-10	1.98	#9	56.3	1.98	2.1139	8	0.183	0.555	0.115	0.995
BFSD2-BPB-11	1.98	#10	63.3	1.98	2.1304	9	0.199	0.624	0.184	1.064
BFSD2-BPB-12	1.98	#11	70.3	1.98	2.1469	10	0.216	0.693	0.253	1.133

Flux Statistics		Blank Statistics	
slope=	0.0099	slope=	#REF!
intercept=	1.9310		
St. Err of Slope=	0.0057		
St Err of Int=	0.0759		
R2=	0.6000		
St Err of Y=	0.0891	St Err of Y=	#REF!
F=	3		
DF=	2	DF=	#REF!
RegSS=	0.023805		
ResSS=	0.01587	ResSS=	#REF!
Sumx2=	16666.5	Sumx2=	#REF!
Average Conc.	2.026		
Initial Conc	1.980		

Comparitive Statistics

$S^2_{(y-x)}$ =	#REF!
$S_{(b1-b2)}$ =	#REF!
t =	#REF!
p =	#REF!

Final Results

Flux =	**41.71**	$\mu g/m^2/day$
95% CI (low) =	**-61.91**	$\mu g/m^2/day$
95% CI (high) =	**145.34**	$\mu g/m^2/day$
% Conf (dif from blank)=	**#REF!**	
Blank Flux=	**0**	$\mu g/m^2/day$
95% CI (low) =	**0**	$\mu g/m^2/day$
95% CI (high) =	**0**	$\mu g/m^2/day$

LINEST statistics

0.0099	1.9310
0.0057	0.0759
0.6000	0.0891
3	2
0.023805	0.01587

Notes

DIBENZ(A,H)ANTHRACENE

Sample id	BFSD 2 Data: Measured Concentration (pptr)**	Sample No.*	Elapsed Time (hrs)	Dilution Correction: Measured Concentration (pptr)**	Corrected Concentration (pptr)**	# of Dilutions	Intercept Corrected Concentration (pptr)	From Regression Concentration (pptr)**	Lower 95% Conf. Int.	Upper 95% Conf. Int.
BFSD2-BPB-1	1.67	T-#0	0	1.67		n/a				
BFSD2-BPB-2	1.67	#1	0.3	1.67	1.6700	0	0.040	0.002	-0.361	0.365
BFSD2-BPB-3	1.67	#2	7.3	1.67	1.6700	1	0.040	0.059	-0.304	0.422
BFSD2-BPB-4	1.67	#3	14.3	1.67	1.6700	2	0.040	0.116	-0.247	0.479
BFSD2-BPB-5	1.86	#4	21.3	1.86	1.8600	3	0.230	0.173	-0.190	0.536
BFSD2-BPB-6	1.67	#5	28.3	1.67	1.6716	4	0.042	0.230	-0.133	0.593
BFSD2-BPB-7	1.67	#6	35.3	1.67	1.6716	5	0.042	0.287	-0.076	0.650
BFSD2-BPB-8	1.67	#7	42.3	1.670	1.672	6	0.042	0.344	-0.019	0.707
BFSD2-BPB-9	1.67	#8	49.3	1.67	1.6716	7	0.042	0.401	0.038	0.764
BFSD2-BPB-10	1.67	#9	56.3	1.67	1.6716	8	0.042	0.458	0.095	0.821
BFSD2-BPB-11	1.67	#10	63.3	1.67	1.6716	9	0.042	0.515	0.152	0.878
BFSD2-BPB-12	1.67	#11	70.3	1.67	1.6716	10	0.042	0.572	0.209	0.935

Flux Statistics		Blank Statistics	
slope=	0.0081	slope=	#REF!
intercept=	1.6296		
St. Err of Slope=	0.0047		
St Err of Int=	0.0627		
R2=	0.6000		
St Err of Y=	0.0736	St Err of Y=	#REF!
F=	3		
DF=	2	DF=	#REF!
RegSS=	0.016245		
ResSS=	0.01083	ResSS=	#REF!
Sumx2=	19096.99	Sumx2=	#REF!
Average Conc.	1.708		
Initial Conc	1.670		

Comparitive Statistics

$S^2_{(y-x)}$ =	#REF!
$S_{(b1-b2)}$ =	#REF!
t =	#REF!
p =	#REF!

Final Results

Flux =	**34.46**	$\mu g/m^2/day$
95% CI (low) =	**-51.14**	$\mu g/m^2/day$
95% CI (high) =	**120.06**	$\mu g/m^2/day$
% Conf (dif from blank)=	**#REF!**	
Blank Flux=	**23.9445835**	$\mu g/m^2/day$
95% CI (low) =	**1.6285102**	$\mu g/m^2/day$
95% CI (high) =	**46.2606567**	$\mu g/m^2/day$

LINEST statistics

0.0081	1.6296
0.0047	0.0627
0.6000	0.0736
3	2
0.016245	0.01083

Notes

BENZO(G,H,I)PERYLENE

Sample id	BFSD 2 Data: Measured Concentration (pptr)**	Sample No.*	Elapsed Time (hrs)	Dilution Correction: Measured Concentration (pptr)**	Corrected Concentration (pptr)**	# of Dilutions	Intercept Corrected Concentration (pptr)	From Regression Concentration (pptr)**	Lower 95% Conf. Int.	Upper 95% Conf. Int.
BFSD2-BPB-1	1.98	T-#0	0	1.9800		n/a				
BFSD2-BPB-2	1.98	#1	0.3	1.9800	1.9800	0	0.047	0.003	-0.418	0.424
BFSD2-BPB-3	1.98	#2	7.3	1.9800	1.9800	1	0.047	0.069	-0.352	0.490
BFSD2-BPB-4	1.98	#3	14.3	1.9800	1.9800	2	0.047	0.135	-0.286	0.556
BFSD2-BPB-5	2.20	#4	21.3	2.2000	2.2000	3	0.267	0.201	-0.220	0.622
BFSD2-BPB-6	1.98	#5	28.3	1.9800	1.9818	4	0.049	0.267	-0.154	0.688
BFSD2-BPB-7	1.98	#6	35.3	1.9800	1.9818	5	0.049	0.333	-0.088	0.754
BFSD2-BPB-8	1.98	#7	42.3	1.980	1.982	6	0.049	0.399	-0.022	0.820
BFSD2-BPB-10	1.98	#9	56.3	1.9800	2.1138	8	0.181	0.531	0.110	0.952
BFSD2-BPB-11	1.98	#10	63.3	1.9800	2.1303	9	0.197	0.597	0.176	1.018
BFSD2-BPB-12	1.98	#11	70.3	1.9800	2.1468	10	0.214	0.663	0.242	1.084

Flux Statistics		Blank Statistics	
slope=	0.0094	slope=	0.003324437
intercept=	1.9332		
St. Err of Slope=	0.0054		
St Err of Int=	0.0726		
R2=	0.6000		
St Err of Y=	0.0852	St Err of Y=	0.01074885
F=	3		
DF=	2	DF=	5
RegSS=	0.02178		
ResSS=	0.01452	ResSS=	2.434381089
Sumx2=	16666.5	Sumx2=	4214
Average Conc.	2.024		
Initial Conc	1.980		

Comparitive Statistics

$S^2_{(y-x)}$ =	0.349843013
$S_{(b1-b2)}$ =	0.01019853
t =	0.598530821
p =	0.568339569

Final Results

Flux =	**39.90**	$\mu g/m^2/day$
95% CI (low) =	**-59.22**	$\mu g/m^2/day$
95% CI (high) =	**139.02**	$\mu g/m^2/day$
% Conf (dif from blank)=	**43%**	
Blank Flux=	**#РЕФ!**	$\mu g/m^2/day$
95% CI (low) =	**#РЕФ!**	$\mu g/m^2/day$
95% CI (high) =	**#РЕФ!**	$\mu g/m^2/day$

LINEST statistics

0.0094	1.9332
0.0054	0.0726
0.6000	0.0852
3	2
0.02178	0.01452

Notes

BFSD 2
Bishop Point Summary- PAHs (Part 1)

PAH	Flux (ng/m²/day)*	+/- 95% C.L. (ng/m²/day)	Flux Rate Confidence (%)	Triplicate Blank Flux (ng/m²/day) Average	Triplicate Blank Flux +/- 95% C.L.	Bulk Sediment (ng/g)	Overlying Water (ng/L)
1. Naphthalene	-110.07	596.59	38.1%	-440.30	458.38	44	13
2. Acenaphthene	2680.41	10124.61	51.2%	-32.40	50.34	3,800	37
3. Acenaphthylene	627.85	1483.64	82.7%	208.47	112.60	1,200	5.6
4. Fluorene	75.17	1894.31	23.4%	-76.74	28.38	4,800	19
5. Phenanthrene	-552.72	1305.06	98.2%	10.95	10.95	54,000	32
6. Anthracene	4053.72	3094.52	100.0%	117.68	64.62	10,000	13
7. Fluoranthene	4435.81	10157.65	97.4%	-1423.95	178.41	270,000	52
8. Pyrene	38.99	4132.12	28.5%	-439.51	70.73	150,000	20

Other							
Oxygen (O_2)* (*ml/m²/day)	-2518.63	152.07	na	na	na	na	na
Silica (SiO_2)* (*mg/m²/day)	na	na	na	-1.97	2.88	na	na

BFSD 2
Bishop Point Summary- PAHs (Part 1, First 4 Samples)

PAH	Flux ($ng/m^2/day$)*	+/- 95% C.L. ($ng/m^2/day$)	Flux Rate Confidence (%)	Triplicate Blank Flux ($ng/m^2/day$) Average	+/- 95% C.L.	Bulk Sediment (ng/g)	Overlying Water (ng/L)
1. Naphthalene	1,848	4,406	59.1%	-440.30	458.38	44	13
2. Acenaphthene	71,053	327,575	100.0%	-32.40	50.34	3,800	37
3. Acenaphthylene	6,862	14,388	100.0%	208.47	112.60	1,200	5.6
4. Fluorene	10,387	110,973	100.0%	-76.74	28.38	4,800	19
5. Phenanthrene	3,031	106,690	99.4%	10.95	10.95	54,000	32
6. Anthracene	26,955	27,293	100.0%	117.68	64.62	10,000	13
7. Fluoranthene	69,812	380,981	100.0%	-1423.95	178.41	270,000	52
8. Pyrene	24,512	190,723	100.0%	-439.51	70.73	150,000	20

Other							
Oxygen (O_2)* (*$ml/m^2/day$)	-2518.63	152.07	na	na	na	na	na
Silica (SiO_2)* (*$mg/m^2/day$)	na	na	na	-1.97	2.88	na	na

BFSD 2
Bishop Point Summary- PAHs (Part 1, Last 8 Samples)

PAH	Flux	+/- 95% C.L.	Flux Rate Confidence	Triplicate Blank Flux ($ng/m^2/day$)		Bulk Sediment	Overlying Water
	($ng/m^2/day$)*	($ng/m^2/day$)	(%)	Average	+/- 95% C.L.	(ng/g)	(ng/L)
1. Naphthalene	27.23	1,194.31	58.0%	-440.30	458.38	44.00	13
2. Acenaphthene	-4,815.36	12,199.50	93.5%	-32.40	50.34	3,800.00	37
3. Acenaphthylene	-1,236.56	1,738.17	100.0%	208.47	112.60	1,200.00	5.6
4. Fluorene	-175.37	2,790.40	29.9%	-76.74	28.38	4,800.00	19
5. Phenanthrene	101.84	1,841.97	43.9%	10.95	10.95	54,000.00	32
6. Anthracene	803.06	2,237.54	99.0%	117.68	64.62	10,000.00	13
7. Fluoranthene	-332.26	14,269.51	31.6%	-1423.95	178.41	270,000.00	52
8. Pyrene	-2,125.92	5,818.50	99.0%	-439.51	70.73	150,000.00	20

Other							
Oxygen (O_2)* (*$ml/m^2/day$)	-2518.63	152.07	na	na	na	na	na
Silica (SiO_2)* (*$mg/m^2/day$)	na	na	na	-1.97	2.88	na	na

BFSD 2
Bishop Point Site Summary- PAHs (Part 2)

PAH	Flux (ng/m^2/day)*	+/- 95% C.L. (ng/m^2/day)	Flux rate Confidence (%)	Triplicate Blank Flux (ng/m^2/day) Average	Triplicate Blank Flux (ng/m^2/day) +/- 95% C.L.	Bulk Sediment (ng/g)	Overlying Water (ng/L)
9. BENZO(A)ANTHRACENE	75.00	306.84	NA	NA	NA	16,000	Non-Detect
10. CHRYSENE	1048.91	1012.24	98.5%	23.94	22.32	48,000	5.1
11. BENZO(B)FLUORANTHENE	919.89	375.56	99.8%	-134.30	297.91	36,000	6.2
12. BENZO(K)FLUORANTHENE	234.99	156.43	93.3%	-9.71	36.30	10,000	2.5
13. BENZO(A)PYRENE	Non-Detect	NA	NA	NA	NA	12,000	Non-Detect
14. INDENO(1,2,3-C,D)PYRENE	6.72	67.06	NA	NA	NA	7,400	1.6
15. DIBENZ(A,H)ANTHRACENE	Non-Detect	NA	NA	NA	NA	1,500	1.5
16. BENZO(G,H,I)PERYLENE	7.91	64.14	11.6%	20.15	65.15	5,300	1.7

BFSD 2
Bishop Point Site Summary- PAHs (Part 2, First 4 Samples)

PAH	Flux	+/- 95% C.L.	Flux rate Confidence	Triplicate Blank Flux ($ng/m^2/day$)		Bulk Sediment	Overlying Water
	($ng/m^2/day$)*	($ng/m^2/day$)	(%)	Average	+/- 95% C.L.	(ng/g)	(ng/L)
9. BENZO(A)ANTHRACENE	Non-Detect	NA	NA	NA	NA	16000	Non-Detect
10. CHRYSENE	8792.74	10650.21	100.0%	23.94	22.32	48000	5.1
11. BENZO(B)FLUORANTHENE	3080.74	17862.28	99.4%	-134.30	297.91	36000	6.2
12. BENZO(K)FLUORANTHENE	977.52	3135.54	99.7%	-9.71	36.30	10000	2.5
13. BENZO(A)PYRENE	Non-Detect	NA	NA	NA	NA	12000	Non-Detect
14. INDENO(1,2,3-C,D)PYRENE	122.97	7142.02	NA	NA	NA	7400	1.6
15. DIBENZ(A,H)ANTHRACENE	Non-Detect	NA	NA	NA	NA	1500	1.5
16. BENZO(G,H,I)PERYLENE	33.19	5249.50	7.0%	20.15	65.15	5300	1.7

BFSD 2
Bishop Point Site Summary- PAHs (Part 2, Last 8 Samples)

PAH	Flux	+/- 95% C.L.	Flux rate Confidence	Triplicate Blank Flux (ng/m^2/day)		Bulk Sediment	Overlying Water
	(ng/m^2/day)*	(ng/m^2/day)	(%)	Average	+/- 95% C.L.	(ng/g)	(ng/L)
9. BENZO(A)ANTHRACENE	Non-Detect	NA	NA	NA	NA	16,000	Non-Detect
10. CHRYSENE	75.45	780.02	29.4%	23.94	22.32	48,000	5.1
11. BENZO(B)FLUORANTHENE	810.32	561.62	99.7%	-134.30	297.91	36,000	6.2
12. BENZO(K)FLUORANTHENE	155.56	270.41	81.2%	-9.71	36.30	10,000	2.5
13. BENZO(A)PYRENE	Non-Detect	NA	NA	NA	NA	12,000	Non-Detect
14. INDENO(1,2,3-C,D)PYRENE	44.68	59.36	NA	NA	NA	7,400	1.6
15. DIBENZ(A,H)ANTHRACENE	Non-Detect	NA	NA	NA	NA	1,500	1.5
16. BENZO(G,H,I)PERYLENE	35.55	101.15	38.6%	20.15	65.15	5,300	1.7

BFSD 2
Bishop Point Demonstration Summary-PCBs

PCB	Flux	+/- 95% C.L.	Flux rate Confidence	Blank Flux ($ng/m^2/day$)		Bulk Sediment	Overlying Water
	($ng/m^2/day$)*	($ng/m^2/day$)	(%)	Flux	+/- 95% C.L.	(ng/g)	(ng/L)
101 - 2,2',4,5,5'-Pentachlorobiphenyl	-2.62	93.70	4%	57.59	31.49	Non Detect	2.1

BFSD 2

Bishop Point Demonstration Summary-Pesticides

Pesticide	Flux (ng/m^2/day)*	+/- 95% C.L. (ng/m^2/day)	Blank Flux (ng/m^2/day)		Bulk Sediment (ng/g)	Overlying Water (ng/L)
			Flux	+/- 95% C.L.		
Mirex	61.81	110.60	NA	NA	Non Detect	1.00

BFSD 2
Paleta Creek Demonstration Summary- PAHs

PAH	Flux	+/- 95% C.L.	Flux Rate Confidence	Triplicate Blank Flux (ng/m^2/day)		Bulk Sediment	Overlying Water
	(ng/m^2/day)*	(ng/m^2/day)	(%)	Average	+/- 95% C.L.	(ng/g)	(ng/L)
1. Naphthalene	459.20	429.58	94.5%	-440.30	458.38	13	6.7
2. Acenaphthene	337.58	178.97	100.0%	-32.40	50.34	19	9.7
3. Acenaphthylene	105.51	183.82	33.8%	208.47	112.60	220	7.6
4. Fluorene	173.17	149.76	100.0%	-76.74	28.38	34	2.3
5. Phenanthrene	489.25	659.77	100.0%	10.95	10.95	240	8.2
6. Anthracene	569.42	260.29	100.0%	117.68	64.62	470	5.3
7. Fluoranthene	365.55	397.63	100.0%	-1423.95	178.41	890	37
8. Pyrene	951.97	755.67	100.0%	-439.51	70.73	740	13

Other							
Oxygen (O_2)* (*ml/m^2/day)	-2193.62	146.52	na	na	na	na	na
Silica (SiO_2)* (*mg/m^2/day)	na	na	na	-1.97	2.88	na	na

BFSD 2
Paleta Creek Demonstration Summary- PAHs (Part 2)

PAH	Flux (ng/m^2/day)*	+/- 95% C.L. (ng/m^2/day)	Flux rate Confidence (%)	Triplicate Blank Flux (ng/m^2/day) Average	Triplicate Blank Flux (ng/m^2/day) +/- 95% C.L.	Bulk Sediment (ng/g)	Overlying Water (ng/L)
9. BENZO(A)ANTHRACENE	Non-Detect	NA	NA	NA	NA	500	
10. CHRYSENE	Non-Detect	NA	NA	23.94	22.32	830	
11. BENZO(B)FLUORANTHENE	Non-Detect	NA	NA	-134.30	297.91	1400	
12. BENZO(K)FLUORANTHENE	Non-Detect	NA	NA	-9.71	36.30	470	
13. BENZO(A)PYRENE	Non-Detect	NA	NA	NA	NA	790	
14. INDENO(1,2,3-C,D)PYRENE	-65.35	906.77	NA	NA	NA	470	1.40
15. DIBENZ(A,H)ANTHRACENE	Non-Detect	NA	NA	NA	NA	120	
16. BENZO(G,H,I)PERYLENE	-46.63	263.97	67.7%	20.15	65.15	400	1.40

BFSD 2
Paleta Creek Demonstration Summary-PCBs

PCB	Flux (ng/m^2/day)*	+/- 95% C.L. (ng/m^2/day)	Flux rate Confidence (%)	Blank Flux (ng/m^2/day) Flux	Blank Flux (ng/m^2/day) +/- 95% C.L.	Bulk Sediment (ng/g)	Overlying Water (ng/L)
18 - 2,2',5-Trichlorobiphenyl	52.21	103.93	4%	76.82	36.49	2.6	ND
28 - 2,4,4'-Trichlorobiphenyl	41.52	80.03	61%	-8.05	82.03	2.2	1.1
52 - 2,2',5,5'-Tetrachlorobiphenyl	9.44	105.28	77%	72.74	28.12	4.9	3
66 - 2,3',4,4'-Tetrachlorobiphenyl	-19.94	62.01	96%	37.74	25.45	5.3	ND
101 - 2,2',4,5,5'-Pentachlorobiphenyl	45.99	84.58	17%	57.59	31.49	13	ND
118 - 2,3',4,4',5-Pentachlorobiphenyl	-2.34	123.95	9%	2.51	15.40	13	ND
153 - 2,2',4,4',5,5'-Hexachlorobiphenyl	22.26	78.55	43%	9.45	11.71	23	0.11

BFSD 2
Paleta Creek Demonstration Summary-Pesticides

Pesticide	Flux	+/- 95% C.L.	Blank Flux ($ng/m^2/day$)		Bulk Sediment	Overlying Water
	($ng/m^2/day$)*	($ng/m^2/day$)	Flux	+/- 95% C.L.	(ng/g)	(ng/L)
2,4'-DDT	57.49	95.75	NA	NA	3.6	0.88
4,4'-DDT	31.23	55.47	NA	NA	14	ND
Dieldrin	-23.48	45.68	NA	NA	2	ND
Hexachlorobenzene	23.76	35.20	NA	NA	0.61	ND
Mirex	36.23	154.93	NA	NA	ND	ND

Appendix C

Standard Procedures and Checklists

****

BFSD 2
ON DECK FINAL CHECKLIST

1. **Establish Laptop communications and verify "Sensor Check/Br^- Injection" program file is loaded.**
2. **Oxygen Tank - Turn Valve ON**
3. **Br^- Injection Valve OPEN (in-line position)**
4. **Sensor Caps - Slide CTD back and REMOVE O_2 & pH storage solution caps (reinstall CTD)**
5. **Vacuum Check - Assure bottles #2- #12 have >25 in-Hg**
6. **INSTALL Check Valve plugs in bottles #2 - #12 (hand tight + ½ turn)**
7. **Check each insertion lever movement and light function**
8. **Check Camera FOV – Coverage of Insertion lights, lid closure, collection chamber & Br^- Injection vent bubbles**
9. **Open & latch lid - set rotary latch for ½ turn**

10. Evacuate Bottle #1 to >25 in-Hg and install check valve plug

11. Rig release hasp and proceed to <u>water entry</u>

BFSD 2
IN WATER FINAL PROCEDURE/CHECKLIST

1. Lift BFSD, remove wheels and suspend over water

2. Submerge fully, stop and inspect for evidence of leakage

3. Lower to within view of bottom and inspect surface for adequate landing and seal potential

4. Execute bottom landing/chamber insertion by either

a. slowly descending and assuring insertion light function with minimum loss of visibility, or

b. rapidly descending and assuring insertion light function with possible impaired visibility.

<u>IMPORTANT</u> – Surface vessel must be able to hold position (+/- ~50 feet) for next 30 minutes (max). Overboard cables must not be allowed to tighten and disturb BFSD insertion.

5. Run "Sensor Check/Br^- Injection" program and visually verify lid closure followed by vent bubbles (Br^- Injection). Verify commands for CTD, pump and sensor operation by evidence of laptop computer data. After ~10 minutes, upload data, paste into Excel template and establish ambient O_2 level and control values.

6. Modify final test program with selected O_2 control limits and download to CTD - <u>verify</u> all loops

7. Run final test program and if surface vessel position hold allows, verify operation from laptop data.

8. <u>Important</u> – <u>*First*</u> close Laptop communications interface and *then* disconnect cables

9. Install and tape watertight connectors, bundle cables and cast overboard - clear of BFSD location

10. Record location, weather conditions, etc, and secure for departure

<u>BFSD 2</u>
<u>SHORESIDE DEPLOYMENT PREPARATIONS</u>

1. Batteries checked/replaced/refreshed:
   a. Gel cell charged to 24 Vdc @ 25 ma rate
   b. 14 new D-Cells - pump
   c. 6 new 9 Vdc batts - acoustic receiver
   d. 1 new D-Cell - landing lights
   e. CTD checked for 10+ Vdc

2. All components cleaned:
   a. Sample bottles cleaned, assembled and vacuum checked (with slow leakers identified for early positions)
   b. Pneumatic syringe cleaned and loaded w/52 ml Br^- concentrate
   c. Valves/tubing fully rinsed and dried
   d. Chamber cleaned (and "bagged" if req'd)

3. Check loops confirm all subsystems operational

4. Rotary valves in "start" position

5. **Bottles installed and >25 in-Hg applied (any slow leakers in early positions).**

6. **O_2 pressure checked and adequate for deployment**

7. **Pneumatic syringe installed**

8. **Acoustic Receiver prepared:**
   a. Ground plate sanded/buffed clean of deposits
   b. Switch in “ON” position
   c. Burn wire (with one wire removed) installed
   d. Function test performed

8. **Sensors Calibrated**

9. **Laptop Status**
   a. **Loops designed & checked**
   b. **File structure set up (Operations: Loops Library/Data)**
   c. **Template functions adjusted for calibrations**

BFSD 2
DEPLOYMENT EQUIPMENT LIST

1. **Cables**
   - **one 75’ primary underwater 3-cable set (Comm, Video, light)**
   - **three Pigtail cables for Laptop comm, TV/VCR, Light**
   - **Underwater connector plugs**

2. **Computer Case**
   - **Laptop computer**
   - **AC Power supply**
   - **Log book**
   - **Check lists, cheat sheets, etc**
   - **Floppy drive w/data discs**
   - **Mouse w/pad**

3. **TV/VCR, controller, VHS Tape(s)**

4. **Video camera power supply**

5. **Tool box**

6. **Extension cord/power strip**

7. **Hand vacuum pump**

BFSD 2
RETRIEVAL/RECOVERY CHECKLIST

1. **Stand off from deployment location > 100' and transmit coded sonar pulse using EdgeTech deck unit (2 series of pulses). Allow 15 min (max) for buoy to deploy and reach surface.**

2. **Prepare deck hoist equipment and attach to buoy line**

3. **Raise to a visible depth and inspect/clear any fouling.**

4. **Raise above surface, open and secure lid, and washdown over water. Clear cables and haul onboard**

5. **Haul over deck, install pneumatic wheels and lower to deck**

6. **Turn Oxygen tank valve "off"**

7. **Verify system is shut down (ie, pump off). Inspect for damage, leakage and/or other abnormalities**

8. **Inspect and note bottle fill conditions, Br^- syringe injection condition, and measure "scum" line location**

9. **Slide CTD back and install pH and O_2 storage caps**

10. **Disconnect "comm" cable plug and upload data to prepared file location. Record copy of data to floppy disc.**

11. **Remove and label sample bottles one at a time, capping inlet port immediately upon removal of teflon fill tube.**

12. **Disconnect cables and plug open connectors. Secure cables.**

13. Thoroughly wash down with fresh water and flush valves/tubing with fresh/DI water without delay

<u>BFSD 2</u>

<u>Sample Bottle Cleaning and Preparation</u>

1. Disassembly for cleaning (After sample removed)

   a. By hand, unscrew and remove lid from bottle. <u>Avoid gripping and turning filter holder</u>. Set bottle aside.

   b. By hand, unscrew filter holder halves. <u>Avoid gripping and turning bottle lid</u>. Using tweezers, remove membrane filter and store in marked Petre dish (if required). Remove orange O-ring and, using blunt object, dislodge and remove black filter support. Set lid/lower filter holder, O-ring and support assembly aside.

   c. Using crescent wrench, unscrew and remove plug from top of check valve (if still there), then unscrew and remove spring retainer from top of check valve. Remove spring and valve plunger. Set parts aside.

   d. Using crescent wrench, unscrew and remove tubing plug from upper filter holder/tee assembly. Set parts aside.

2. Cleaning

   a. Rinse all parts in tap water to remove loose material.

   b. Rinse all parts thoroughly in deionized water.

   c. Soak all parts in 4% RBS solution for 4 hours minimum (24 hours preferred)

   d. Rinse all parts in deionized water

   e. Soak sample bottles and teflon tubing plugs in 25% nitric acid solution for 4 hours minimum (24 hours preferred)

   f. Soak Upper and lower filter holder assemblies, orange O-rings and black filter supports in 10% nitric acid for 4 hrs (24 hours is OK but NOT preferred).

   g. Rinse all parts in deionized water followed by thorough rinsing with 18meg-ohm water.

h. Set all parts in vented hood and allow to thoroughly air dry (overnight is preferred).

3. Assembly and preservation

a. Assemble in the reverse the order of 1. above, with the following additions:

- **Apply a very thin layer of silicon grease to the check valve O-ring. Using the attached spring, lower the assembly into the check valve body and fully rotate it several times against the mating seat. Secure the spring with the retainer and tighten with a crescent wrench.**
- **Snap a black filter support into the lower filter holder/lid assembly. Using tweezers, secure a membrane filter and position it on top of the filter support. Position an orange O-ring on top of the membrane filter and hand tighten the upper filter holder assembly in place. Securely tighten the assembly taking care not to grip and/or rotate the lid.**
- **Assemble a tube plug and tighten with a crescent wrench.**
- **Install a teflon gasket into the sample bottle lid (if used) and securely tighten the lid assembly to the sample bottle. Avoid gripping and/or turning the filter holder.**
- **Using a hand vacuum pump, evacuate the finished assemble to 25 in-Hg and set aside for 4 hours minimum (24 hours is preferred).**
- **If no leakage occurs, sample bottles may be used. If slight leakage occurs on a few, they may be labled and used early in sample sequence. Leakage may be resolved by further tightening of sample bottle lid. Any leakage resolution requiring disassembly shall include cleaning as above.**

Table of Contents

List of Figures

List of Tables

Quantifying *In Situ* Metal and Organic Contaminant Mobility in Marine Sediments

Space and Naval Warfare Systems Center San Diego, CA

January 1, 2008

1. Introduction

1.1 Background Information

Contaminants enter shallow coastal waters from many sources, including ships, shoreside facilities, municipal outfalls, spills, and non point-source runoff. Sediments are typically considered a primary sink for these contaminants. Sediments in many bays, harbors and coastal waters used by DoD are contaminated with potentially harmful metal and organic compounds. The DoD is required by the Comprehensive Environmental Resource Conservation and Liability Act, as amended by the Superfund Amendment and Reauthorization Act of 1986 (CERCLA/SARA), to assess and if necessary remove and remediate these sites and discharges in order to protect the public health or welfare of the environment. To determine whether contaminants are moving into, out of, or remaining immobilized within the sediments, a determination of contaminant flux must be made. Variations in sediment chemical and physical properties make it impossible to rely on bulk sediment contaminant concentrations alone to predict contaminant flux, bioavailability, and therefore toxicity. Diagenetic reactions in surface sediments control contaminant pore water gradients, and the direction and magnitude of these gradients control the diffusive flux across the sediment-water interface. These fluxes can be calculated from measurements of contaminant pore water gradients and sediment physical properties. However, in some coastal areas pore water gradients are very steep and therefore difficult to measure. In addition, flux calculations based on pore water gradients only provide the diffusive component of a contaminant flux. An additional concern in coastal areas is that biological irrigation by infauna and wave or current induced flushing may provide a larger component of flux through advection of water through the sediments. To avoid these problems, a direct measurement of contaminant flux in coastal areas is often the best method to assess contaminant mobility across the sediment-water interface. This direct measurement can be made with a flux chamber that isolates a volume of seawater over the sediments to quantify contaminant flux across the sediment-water interface.

An instrument for measurement of contaminant fluxes from marine sediments called the Benthic Flux Sampling Device 2(BFSD2). The instrument is a commercialized version of the original prototype BFSD used during development and is adapted from benthic flux chamber technology developed in oceanography for studying the cycles of major elements and nutrients on the seafloor.

The BFSD2 is an autonomous instrument for *in-situ* measurement of toxicant flux rates from sediments. A flux out of or into the sediment is measured by isolating a volume of water above the sediment, drawing off samples from this volume over time, and analyzing these samples for increase or decrease in toxicant concentration. Increasing concentrations indicate that the toxicant is fluxing out of the sediment. Decreasing concentrations indicate that the toxicant is fluxing into the sediment.

Figure 1 shows the BFSD2, including its pyramid-shaped tubular frame, open-bottomed chamber, and associated sampling and control equipment. At the top of the frame is an acoustically released buoy for BFSD2 recovery. At the bottom of the frame is an open-bottomed chamber and associated sampling gear, flow-through sensors, a data acquisition and control unit, video camera system, power supply, and oxygen supply system.

Figure 1. Benthic Flux Sampling Device 2.

The BFSD2 provides a unique means of evaluating the significance of in-place sediment contamination. Knowledge of the degree to which contaminants remobilize is essential in defining the most cost effective remedial action at impacted sites. At present, there is no other viable method for direct quantification of sediments as sources. At sites where it can be demonstrated that remobilization of contaminants is limited, significant cost savings may be achieved through reduction of cleanup costs. This may often be the case because many contaminants are strongly sequestered within the sediment and not likely to leach out. Estimated disposal costs for contaminated sediments

range from $100-$1000/cubic yard. A recent survey of Navy shoreside facilities (NRaD, 1995) indicated that of the 31 facilities that responded, 29 reported the presence of contaminated sediment sites. The actual volume of contaminated sediment at these sites is not well-documented however even conservative estimates suggest that millions of cubic yards of material may exceed typical sediment quality guidelines.

1.2 Official DoD Requirement

This project addresses the DoD/Navy requirement for compliance, cleanup assessment, and remediation decisions using innovative technology to directly quantify the mobility and bioavailability of contaminants in marine sediments. Marine sediments serve as a repository for contamination from a wide variety of sources. The environmental risks posed by these contaminants are determined largely by the degree to which they remobilize into the environment.

1.2.1 How Requirements were Addressed

The technology demonstrated in this project provides a means of quantifying risks and supports the overall goal of cost-effective, risk-based environmental cleanup. This technology provides a basis for risk-based decision making and potential cost savings by

1. Improving methods for measuring bioavailability for contaminated sediment
2. Minimizing cleanup requirements at sites where contaminants are not remobilizing
3. Evaluating the integrity of natural and remedial sediment caps
4. Providing a direct measure of the time scale of natural attenuation
5. Documenting the actual contaminant contribution of sediments relative to other sources.

1.3 Objectives of the Demonstrations

The primary objective of the demonstrations of the BFSD2 was to perform deployments at contaminated sites in San Diego Bay, California and Pearl Harbor, Hawaii under the observation of California EPA certification evaluators. Other observers, including local, state and federal regulators, Remediation Program Managers, academic, industry and other DoD also attended. Each site offered different validation opportunities: San Diego Bay was used to show instrument repeatability and comparison with historical trends and Pearl Harbor was used to show site differences and geochemical trend analysis. Organics demonstrations were performed at the same sites. The specific planned objectives of the demonstrations were to:

(1) evaluate the quality of water samples collected using the BFSD2; specifically for use in determining if a statistically significant flux was occurring at the test locations in comparison to the blank flux results for the BFSD2.

(2) evaluate the BFSD2 for repeatability.

(3) evaluate the logistical and economic resources necessary to operate the BFSD2.

(4) evaluate the range of conditions in which the BFSD2 can be operated.

Other objectives included exposure of various user communities to the technology to encourage continued interest and applications.

1.4 Regulatory Issues

There were no regulatory permitting issues associated with deployment of the BFSD2. Collecting sediment samples in a marine environment is considered a nonhazardous activity (although personnel handling samples must follow all safety precautions and limit their exposure to potentially hazardous samples). No hazardous waste was generated during the demonstrations.

The BFSD2 is a sample collection instrument and its prototype was the first of its kind to collect sediment-water interface samples for contaminant flux analysis. Because this technology has no current equivalent, the BFSD2 is evaluated based on the internal quality assurance/quality control (QA/QC) for the laboratory analysis performed and on an analysis and interpretation of the data. Although some clean water standards have been set for seawater, only guidelines currently exist for sediments. And, whereas sample handling, preserving, analyzing and reporting is covered by a number of established methods and regulations, the primary regulatory issue for the BFSD2 involves the integrity of the collected samples to represent ambient conditions. Further, the heterogeneous nature of sediments combined with the complex chemistry of marine aquatic environments requires thoughtful evaluation of all data before arriving at conclusions. The BFSD2 system can routinely produce accurate, precise and repeatable results, however the application of these results to site specific conditions does not lend itself readily to standardized processes. In many cases, BFSD2 results may be used as an additional factor in a "weight of evidence" approach for risk-based decisions involving regulator concurrence.

1.5 Previous Testing of the Technology

Initial development program tests included *ex situ* (laboratory) and *in situ* (field) trials of critical components, subsystems, and systems. A number of system development tests were conducted at various locations within San Diego Bay during 1989-91.

Full-scale system trials of the prototype BFSD were conducted in Sinclair Inlet, offshore from Puget Sound Naval Shipyard, Bremerton WA, during June 1991 in support of an ongoing assessment. Ten deployments of the prototype BFSD were conducted to characterize flux rates of contaminants from seven shipyard sites and three reference sites (no blank test was conducted). Collected samples were analyzed for the trace metals arsenic (As), cadmium (Cd), chromium (Cr), copper (Cu), mercury (Hg), nickel (Ni), lead (Pb) and zinc (Zn). The tests were successful and results generally showed low release rates (or fluxes) compared to other contaminant sources. See general reference 12 for the complete report. Following review of the data, an active oxygen control subsystem with sensor feedback was developed and implemented along with several other changes to improve operation reliability.

During 1993 four systems tests of the upgraded prototype BFSD were conducted at sites within in San Diego Bay: one at Paleta Creek (at its entrance to the bay within Naval Station San Diego); two at a commercial yacht harbor (Shelter Island); and one at a industrial shipping terminal (PACO Industries). The deployments were preceded by a system blank test to determine the lower limits of flux that could be resolved with the prototype BFSD. Several experimental subsystems including a sensor for laser-induced fluorescence (LIF) investigation of polycyclic aromatic hydrocarbon (PAH) contaminants and an electrode for potentiometric stripping analysis (PSA) of trace metal (Cu and Zn) contaminants were also tested. Results from these deployments showed significant flux rates when compared to blank test results and clear differences between the sites as related to potential trace

metal sources. Paleta Creek results showed the highest flux levels for Cd, Cu, Ni and Zn. See reference 5 for the complete report.

Seven more prototype BFSD deployments in San Diego Bay in support of a sediment quality assessment at Naval Station San Diego were conducted during 1995. Paleta Creek was again included along with five other sites near piers and quay walls and one site outside the study area used as a reference. The work, preceded by a blank test, yielded results that were consistent with the previous study and showed Cd, Ni, Zn and Mn all to have positive fluxes. Paleta Creek again showed the highest trace metal fluxes with levels which were generally consistent with those measured two years prior. Correlations between measured trace metal flux levels and complex marine chemistry processes were studied and informative trends were identified. For example in the complex oxidation-reduction (redox) marine environment, it was found that trace metal fluxes are consistent with oxidation of solid metal sulfides as a sediment source. See key reference 7 for the complete report; an extract is included below to illustrate an initial interpretation of the Naval Station San Diego results:

> Some of these trace metal flux relationships may be better illustrated with bar charts showing the trends along a series of transects across the study area. Figures2 and 3 show the trace metal fluxes for the 1995 deployments along with data from the earlier 1993 deployments. The Zn fluxes in Figure 2 are so large that the other trace metal fluxes are barely visible, so the other metal fluxes are replotted in Figure 3 without Zn. This demonstrates that Zn is, by far, the trace metal with the largest flux out of the sediments. The first site displayed in both figures is the blank run, followed by the east-west transects near Pier 4 (Sites 3, 3r, 1r, and 2) and Paleta Creek (Sites 5, 4, and 6), and finally the 1993 data. Zn, Ni, and Cd fluxes in the 1995 data are high in the east (Sites 3 and 5) and decrease toward the west, and in the 1993 data higher in the central bay sites compared to north bay sites. The trends for Cu and Pb fluxes are less clear, with some sites showing fluxes into the sediments. Cu does, however, show the highest fluxes out of the sediments at Sites 3 and 5 where the sediment concentrations of most metals are high.

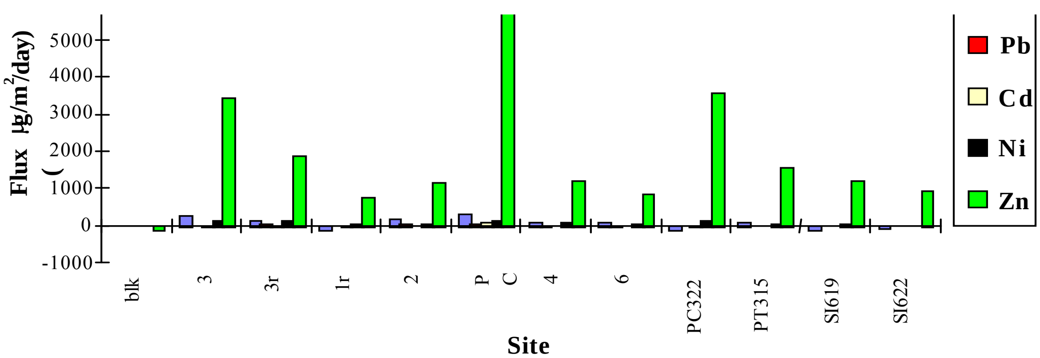


Figure 2. Plot of Metal Fluxes Along East-west Transects.

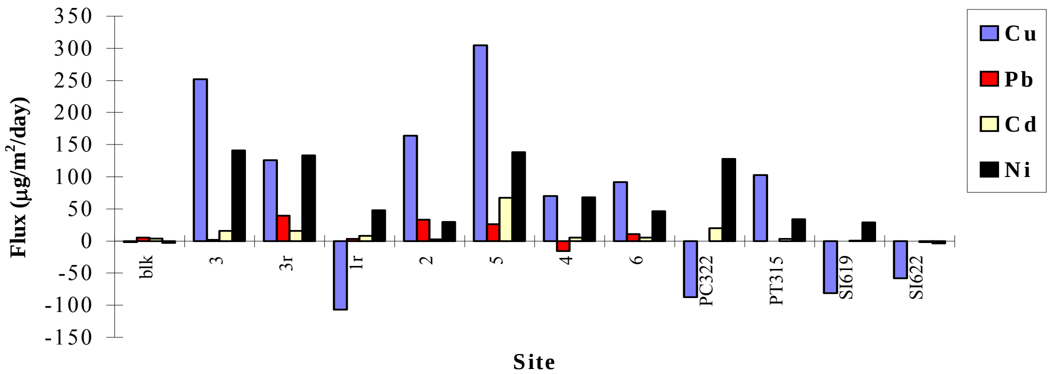


Figure 3. Plot of Metal Fluxes Along East-west Transects, Excluding Zn.

Looking at the NAVSTA area sediments out to the west side of the navigation channel, a surface area of approximately 3 million square meters (m2) is present. From the contour map of Zn concentrations in the sediment chemistry chapter, only approximately 500,000 m2 are above the ERM value of 410 ppm. The four Zn flux measurements from sediments with these high Zn levels (Sites 1R, 3, 3R, and 5) average 3100 + 2500 ug/ m2 / day. Sediments in the NAVSTA area with Zn levels below ERM values cover approximately 2.5 million m2 and three flux measurements from sediments with lower Zn levels average 1100 + 200 ug/ m2 / day. The overall flux of zinc directly from the sediments in the NAVSTA area is therefore 1500 + 600 kg Zn/ yr.

Finally, as mentioned above, blank tests of the prototype BFSD were conducted to determine the lowest levels of contaminants which could be resolved with the system. With the prototype BFSD prepared as it would be for a normal deployment, the test was conducted in seawater with the chamber sealed. A time-sequence for sample collection comparable to the planned deployments was used and the samples were analyzed identical to later site-collected samples. For the San Diego Bay tests discussed above the results were:

Coumpound	flux ± S.E.	(µg/m2/day)
	1993	1995
Cadmium	6 ± 7	5 ± 3
Copper	-71 ± 62	-2 ± 47
Iron	--	160 ± 235
Lead	-4 ± 8	7 ± 67
Manganese	--	-52 ± 26
Nickle	65 ± 69	-4 ± 27
Zinc	-227 ± 65	-149 ± 267

Whereas the prototype BFSD performed successfully and was considered mature enough to begin technology transfer, the process of data analysis and interpretation revealed complexities requiring careful consideration prior to reaching conclusions. Technology transfer, to be fully discussed in section 8, began with a competitively awarded firm-fixed-priced contract for Benthic Flux Sampling Device 2 (BFSD2), which incorporated a number of changes from the prototype BFSD. A series of

ex situ and *in situ* tests and tests and checkouts assured that the instrument retained critical prototype BFSD performance attributes as well as establishing functionality of the changed features. A complete series of laboratory (e*x situ*) tests and checkouts were conducted. *Ex situ* tests included: the new rotary valve sampling system to assure reliable performance; the pump and diffuser system with dye-dispersion to assure adequate mixing; the flow-through sensor system to assure responsive and accurate readings; the vacuum-filled, *in situ*-filtered sample bottles to assure clog-free operation and adequate fill volume; and the data acquisition and control system to assure required performance.

2. Technology Description

2.1 Description

Contaminants enter shallow coastal waters from many sources, including ships, shoreside facilities, municipal outfalls, spills, and non point-source runoff. Sediments are typically considered a primary sink for these contaminants. Where previous shoreside practices have resulted in high concentrations of contaminants in the sediments, contaminants may flux out of the sediments. Also, in areas where pollution prevention and remediation practices have removed other contaminant sources, remaining contaminated sediments may serve as a primary contaminant source to the water column.

To determine whether contaminants are moving into, out of, or remaining immobilized within the sediments, a determination of contaminant flux must be made. Diagenetic reactions in surface sediments control contaminant pore water gradients, and the direction and magnitude of these gradients control the diffusive flux across the sediment-water interface. These fluxes can be calculated from measurements of contaminant pore water gradients and sediment physical properties. However, in some coastal areas pore water gradients are very steep and therefore difficult to measure. In addition, flux calculations based on pore water gradients provide only the diffusive component of a contaminant flux. An additional concern in coastal areas is that biological irrigation by infauna and wave or current induced flushing may provide a larger component of flux through advection of water through the sediments. To avoid these problems, a direct measurement of contaminant flux in coastal areas is required to assess contaminant mobility across the sediment-water interface. This direct measurement can be made with a flux chamber that isolates a volume of seawater over the sediments to quantify contaminant flux across the sediment-water interface.

The Navy-designed and developed, contractor-fabricated Benthic Flux Sampling Device 2 (BFSD2) is a flux chamber designed specifically for *in situ* measurement of contaminant fluxes in coastal areas. A chamber of known volume encloses a known surface area of sediment. Seawater samples are collected periodically at timed intervals. After a laboratory has analyzed the samples, and with knowledge of the time intervals between samples, a flux rate between the sediment and water in mass per surface area per unit time (micrograms per square meter per day [$\mu g/m^2$/day]) can be calculated.

The BFSD2, shown in Figure 4 with key components labeled, consists of an open-bottomed chamber mounted in a modified pyramid-shaped tubular framework with associated sampling gear, sensors, control system, power supply, and deployment and retrieval equipment. The entire device is approximately 1.2 by 1.2 meters from leg to leg and weighs approximately 175 pounds. The lower part of the framework contains the chamber, sampling valves, sampling bottles, and batteries. The upper frame includes a release that is acoustically burn-wire triggered. The BFSD2 is designed for use in coastal and inland waters to maximum depths of 50 meters. Maximum deployment time is approximately 4 days based on available battery capacity. Figures 5 and 6 illustrate the two basic configurations for landing and sampling events, respectively.

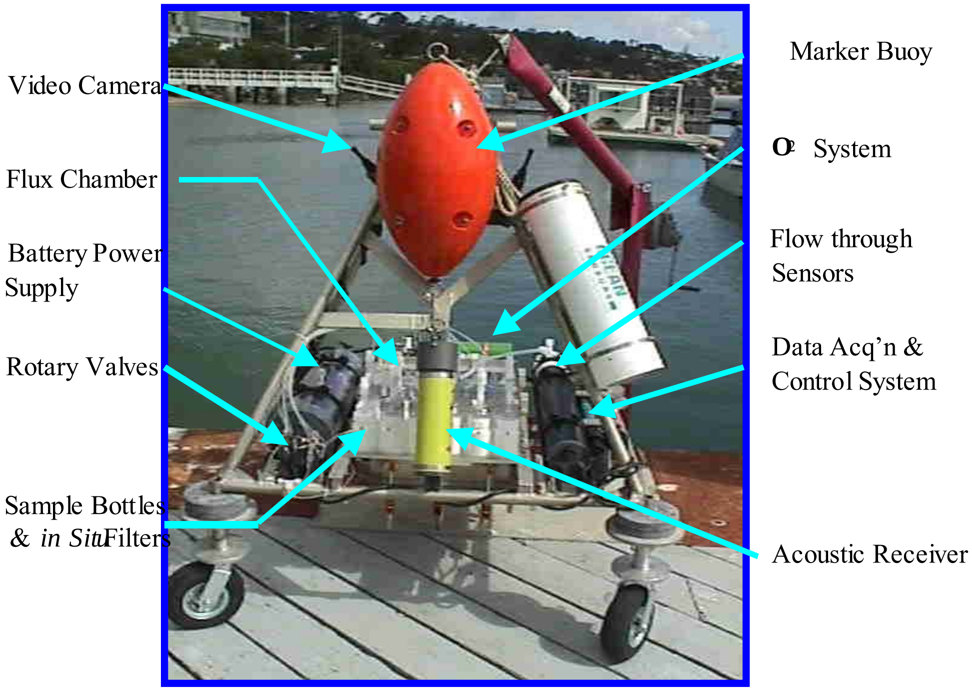
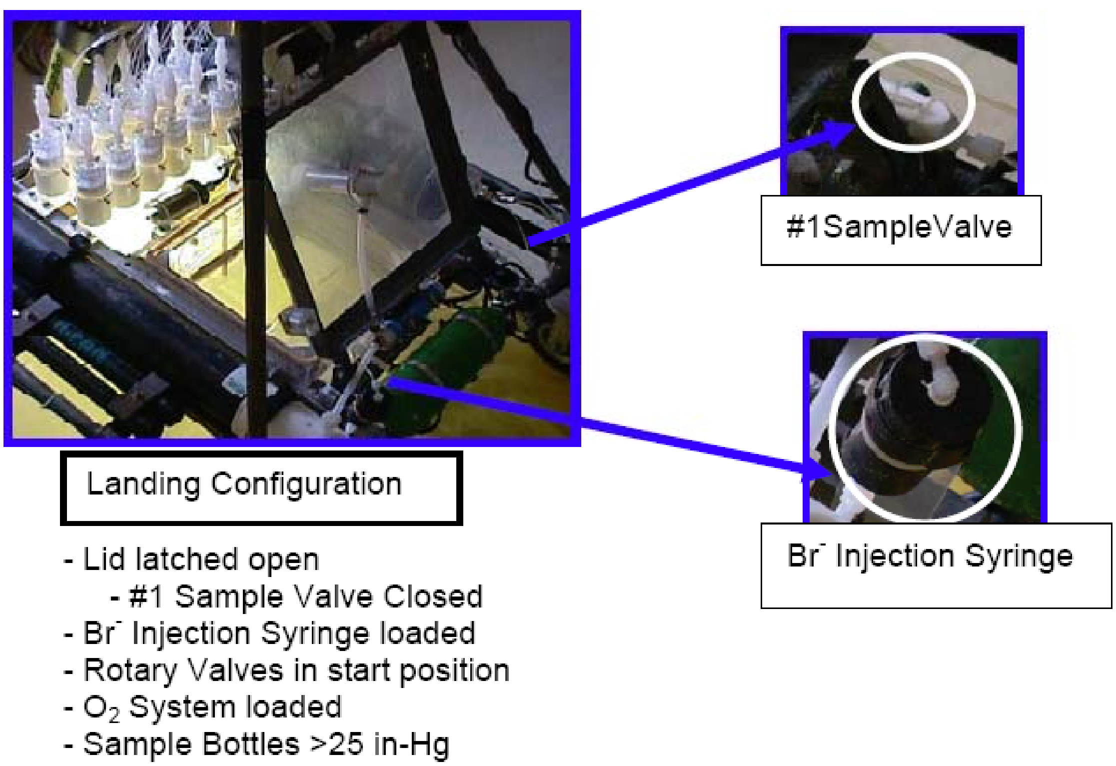


Figure 4. Benthic Flux Sampling Device 2.

Figure 5. BFSD2 Sampling Events.



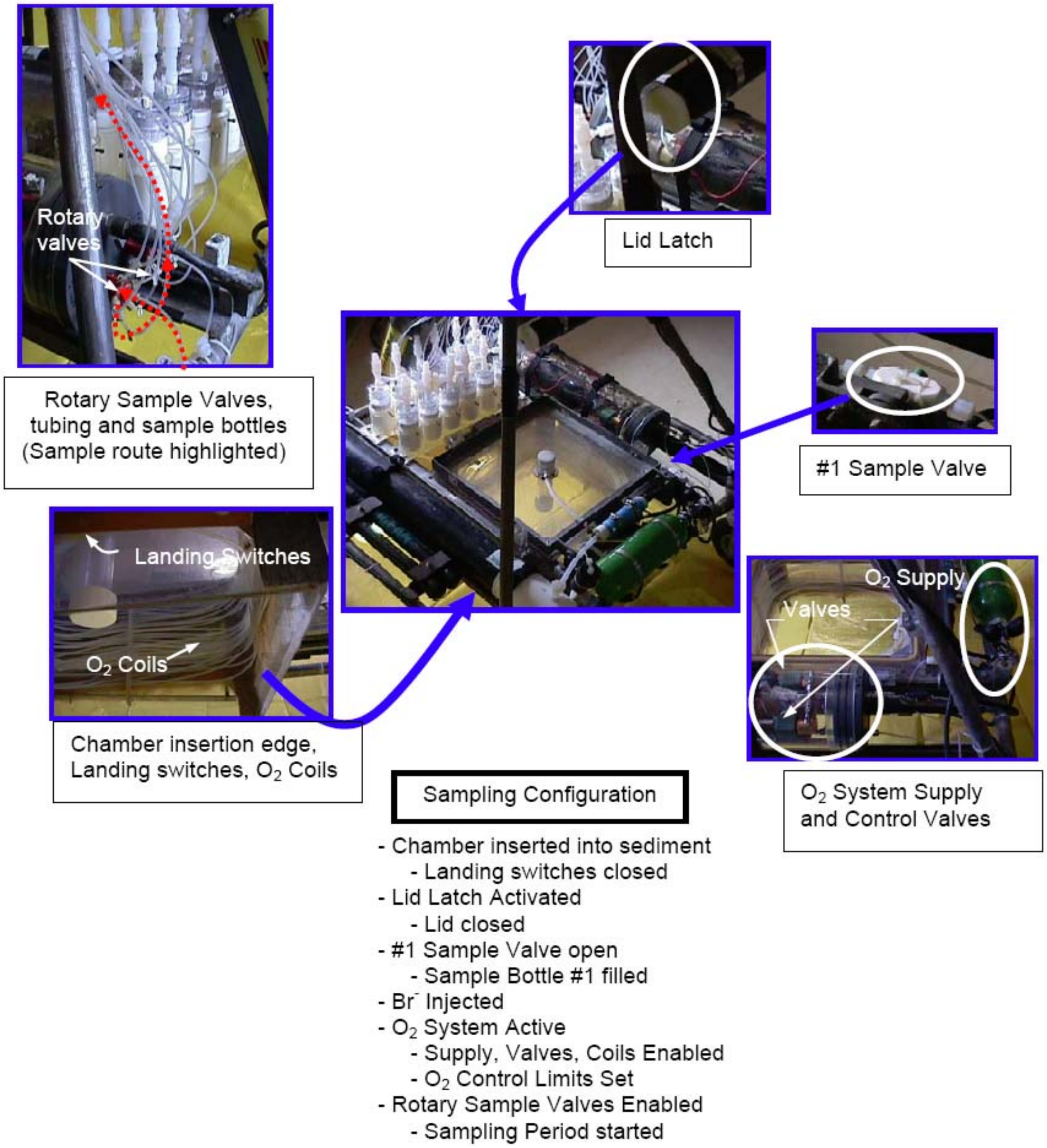


Figure 6. BFSD2 Sampling Events.

2.1.1 Sampling Chamber

The chamber is a bottomless box, approximately 40 centimeters (cm) square by 18 cm tall, with a volume of approximately 30.0 liters (Figure 7). The volume was chosen to allow for a maximum overall dilution of less than 10 percent due to sampling withdrawal into 11 samples of 250 milliliters (ml) each. For the combined demo, 11 combined samples were collected from within the chamber (100 mls for metals and 250 mls for PAH's) increasing the sample volume to 350 mls per sampling

event. This increased the dilution to about 13% for the combined sampling. The chamber is constructed of clear polycarbonate to avoid disrupting any exchanges that may be biologically driven and, thus, light sensitive. To prevent stagnation in the corners of the chamber, triangular blocks of polycarbonate occupy the 90-degree angles. The top of the chamber is hinged at one edge so that it may be left open during deployment to minimize sediment disturbance. Once the chamber is in place, the computer control system closes the lid. A gasket around the perimeter of the chamber ensures a positive seal between the chamber and the lid. Exact alignment is not required, because the lid is slightly larger than the sealing perimeter of the gasket and pivots on two sets of hinges. The lid is held closed by four permanent magnets situated along the chamber perimeter. The bottom of the chamber forms a knife-edge. Pressure-compensated switches mounted on the bottom surface of three sides of a flange circling the chamber at 7.6 cm above the base activate a series of three lights visible with a video camera mounted on the upper frame. Illumination of the lights indicate a uniform minimum sediment penetration depth has been achieved and a good probability that a positive seal between the chamber and the sediment has been achieved.

Figure 7. Chamber Enclosure.

Samples are drawn off through a 4-mm Teflon tube via synchronized parallel rotary valves and into evacuated 250 ml Teflon sampling bottles. For organics applications, standard precleaned 250 ml amber glass sample bottles with pre-combusted glass-fiber filter assemblies are used (Figure 8). For the combined demo, 100 ml Teflon bottles were used for metals and 250 ml amber glass bottles were used for PAH’s.

Figure 8. Sample Bottles. Clockwise from Upper Left, metals Bottles; Organics Bottles; Combined Metals and Organics Configuration; and Paired Bottles for Combined Deployment.

The first sample is drawn through a 0.45 micron-filter into the sample bottle upon closure of the lid at the start of the autonomous operation of the BFSD2; the remaining 11 samples are similarly collected as the synchronized parallel rotary valves are activated at preprogrammed intervals throughout the deployment. The bottles are evacuated to a minimum of 25 inches of mercury before deployment.

2.1.2 Acquisition and Control Subsystem

The acquisition and control unit is an Ocean Sensors Model OS200 conductivity temperature depth (CTD) instrument, modified to allow control of the BFSD2. It consists of a data logger that acquires and stores data from sensors, and a control unit that regulates sampling and other functions of the BFSD2. The data logger collects data from a suite of sensors housed in the CTD and connected to the chamber through a flow-through loop. A small constant-volume pump maintains circulation in the flow-through system to the sensors and is also used to maintain homogeneity of the contents of the chamber utilizing a helical diffuser mounted vertically on the central axis of the box. The control unit closes the lid, activates the flow-through/mixing pump, activates dissolved oxygen control valves, and controls activation the synchronized parallel rotary sampling valves. Commercial sensors, installed by Ocean Sensors, Inc., are mounted in the CTD instrument housing, and are connected to the chamber by means of a flow-through pump and circulation plumbing. Sensors are used for monitoring conditions within the chamber, including conductivity, temperature, pressure, salinity, pH, and dissolved oxygen, Figure 9. Circulation in the flow-through sensor system is maintained using a constant flow rate pump adjusted to approximately 15 milliliters per second (ml/sec).

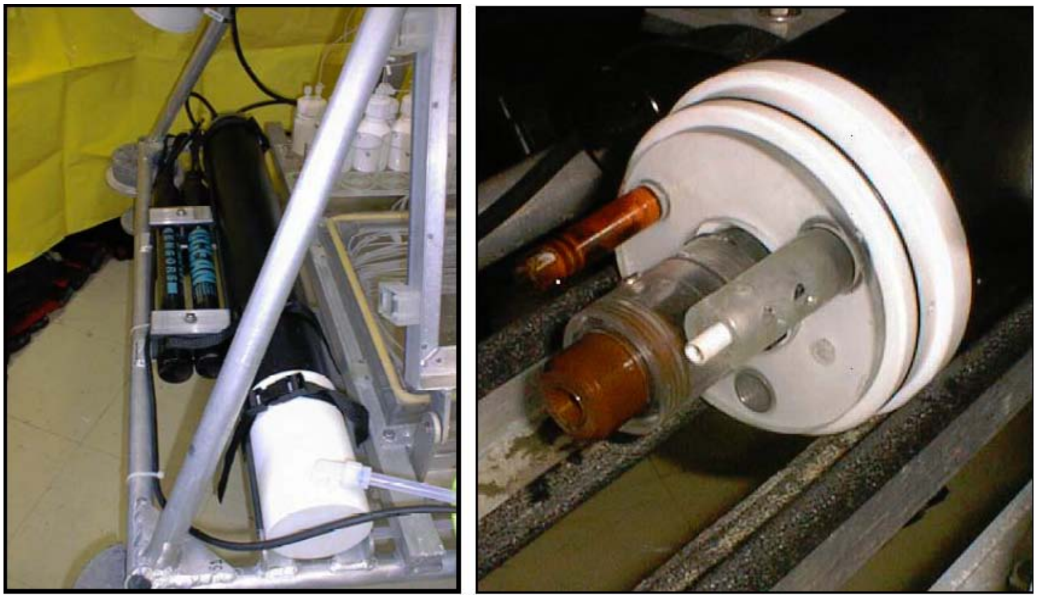


Figure 9. Flow-Through Sensor System.

2.1.3 Sampling Subsystem

Discrete samples are obtained using a vacuum collection approach consisting of sample containers, fill lines, in-line filters (with 0.45 micron membrane filters for metals or with 1.0 micron pre-combusted glass-fiber filters for organics), check valves, and synchronized parallel rotary valves connected to the chamber fill line. Off-the-shelf 250ml Teflon (metals) or amber-glass (organics) collection bottles are modified to allow filling through the cap. Sampling containers of any volume, material, or shape may be used, provided the cap can be modified to accept the fill line connection, the bottle wa lls are strong enough to withstand the pressure at the sampling depth, and the cap sea l is airtight and watertight at the sampling depth pressure. Glass, Teflon, and polycarbonate bottles have been tested and used successfully with the prototype BFSD. All valves, fittings, and tubes are made of Teflon or other nonmetallic materials to minimize potential metal contamination of samples and to facilitate cleaning. Samples are drawn from the chamber through a 4-mm Teflon tube connected to the rotary valves and into the sampling bottles. Sampling is initiated by the control system when it activates the valves at preprogrammed intervals. Seawater samples are drawn through the sampling system by a vacuum of 25 inches of mercury (minimum) which is applied to all sample bottles through check valves mounted in the bottle lids. The check valves are then sealed, and water enters each sample bottle when the rotary valves are activated (number 2 through 12) or when the lid closes and opens a valve attached to its hinge (number 1). Filtered seawater flows into each bottle until pressure is equalized, normally yielding at least 240ml.

2.1.4 Circulation Subsystem

The BFSD2 has a mixing area called the collection chamber and the process of interest is the exchange of chemical contaminants at the sediment-water interface sequestered within the chamber. The hydrodynamics inside the chamber must adequately simulate movement of water from near-bottom currents outside the chamber. For this purpose, a helical diffuser mounted vertically on the central axis of the chamber is used to mix the enclosed volume. Tests recorded on video verified that the helical diffuser provided a uniform, gentle mixing action that effectively dispersed dye injected into the chamber without disturbing the sediment layer on the chamber bottom.

The diffuser system includes a standard constant-volume submersible pump. The pump circulates water from an outlet in the chamber wall, into the sensor chamber and over the flow-through sensors, and back into the chamber via a rigid polycarbonate tube. The vertically mounted tube is capped at the discharge end and has 5mm holes drilled in a helix pattern along its length. The tests verified that this method visually dispersed a dye injection of Rhodamine in less than 120 seconds.

The acquisition and control unit, the oxygen supply bottle, a video camera and lighting system, circulation pumps, and the retrieval line canister are mounted on the frame members. The oxygen system is used to maintain aerobic conditions within the chamber by diffusing oxygen at a rate sufficient to maintain the initial dissolved oxygen levels through a coil of thin-walled, oxygen-permeable Teflon tubing.

2.1.5 Oxygen Control Subsystem

Over the course of an experiment, conditions in the isolated volume of seawater within the flux chamber begin to change from the initial conditions observed in the bottom water. Oxygen content is one factor that changes rapidly because isolated volumes of seawater in contact with the sediment surface will become anoxic without any resupply of oxygen. Since the fluxes of many contaminants, especially metals, are sensitive to redox conditions, the oxygen content is one of the most important factors that must b e monitored and regulated within the flux chamber. Most contaminant fluxes are not large enough to be measured in chambers without oxygen regulation because the isolated volume of seawater will become anoxic before significant contaminant fluxes have occurred. Because of this, an oxygen control system has been built into the BFSD2. This system maintains the oxygen levels in the chamber within a user-selected window about the measured bottom water oxygen level.

The oxygen regulating system consists of a supply tank, pressure regulator, control valves, diffusion coil, oxygen sensor, and control hardware and software. The supply tank is a 13-cubic foot aluminum diving tank equipped with a first-stage regulator that allows adjustment of output pressure to the system. The control valves are housed within a watertight pressure case with connections through bulkhead fittings on the end cap. The diffusion coil is thin-walled, 4-mm, oxygen-permeable, Teflon tubing approximately 15 meters (m) long. Oxygen is monitored using the oxygen sensor in the flow-through system described previously. The oxygen control valves (pressurize or vent) activation is incorporated into the control system of the BFSD2.

During a typical deployment, when the flux chamber is initially submerged, the ambient oxygen level in the water is measured with a control program which activates the circulation subsystem and sensors until a stable value of ambient oxygen concentration is obtained. This is performed with the BFSD2 either on the bottom or suspended less than 1 meter above the sediment (with the lid open). When oxygen stability is obtained, the user then establishes a maximum and a minimum oxygen control level, based on a userspecified range around the stable ambient level. Figure 10 is a typical set of data obtained from 15 minutes of operation. The control limits are entered into the operational control program and downloaded to the BFSD2 acquisition and control subsystem. When autonomous operations are started and the chamber is closed and sealed, the oxygen level inside the chamber is monitored by the control program. If the level drops below the allowable minimum, a control valve is momentarily opened, the diffusion coil is pressurized, and the oxygen level in the chamber begins to increase. When the oxygen level reaches the maximum allowable level, another control valve is activated and the pressurized tubing is vented. This sequence is repeated continuously during deployment, maintaining the oxygen level in the chamber near the ambient level. Figure 11 is a typical set of data obtained from a 72-hour deployment. Note that dissolved oxygen concentrations are reported in ml/l in this report. Dissolved oxygen concentrations in seawater can

be expressed in millimolar, uMoles/kg, mg-atoms/liter, mg/liter, ml/liter or percent saturation. Conversion from mg/l to ml/l is a linear computation (mg/l x 1.4276 = ml/l). It is true Standard Methods suggests re porting in mg/l, however different reporting units are found in the literature. We have historically used oxygen sensors obtained through Seabird Electronics, and their calibration procedures and software all use ml/l for dissolved oxygen concentrations.

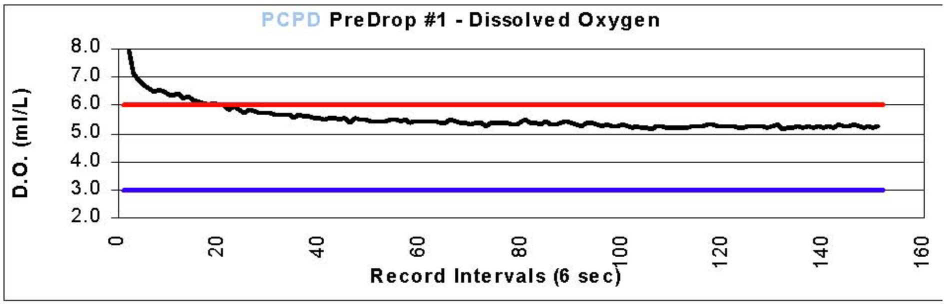


Figure 10. Ambient Oxygen Data.

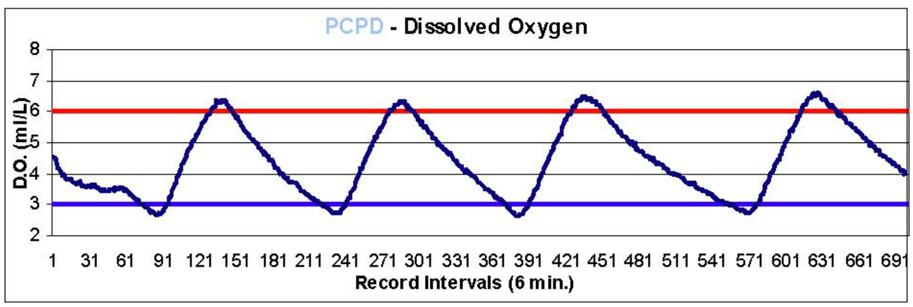


Figure 11. Operational Oxygen Control Data.

2.1.6 Deployment and Retrieval Subsystems

During deployment the test site is surveyed for obstacles with a light-aided video camera mounted on the upper frame of the BFSD2 using a on deck television monitor. As shown in Figure 12, a deployment cable and release line are used to lower the BFSD to its intended depth for the video inspection. Following either rapid or slow descent to the bottom, the minimum depth of collection chamber insertion is sensed by pressure-compensated switches, which activate lights mounted on the chamber frame. These lights are TV-monitored on deck.

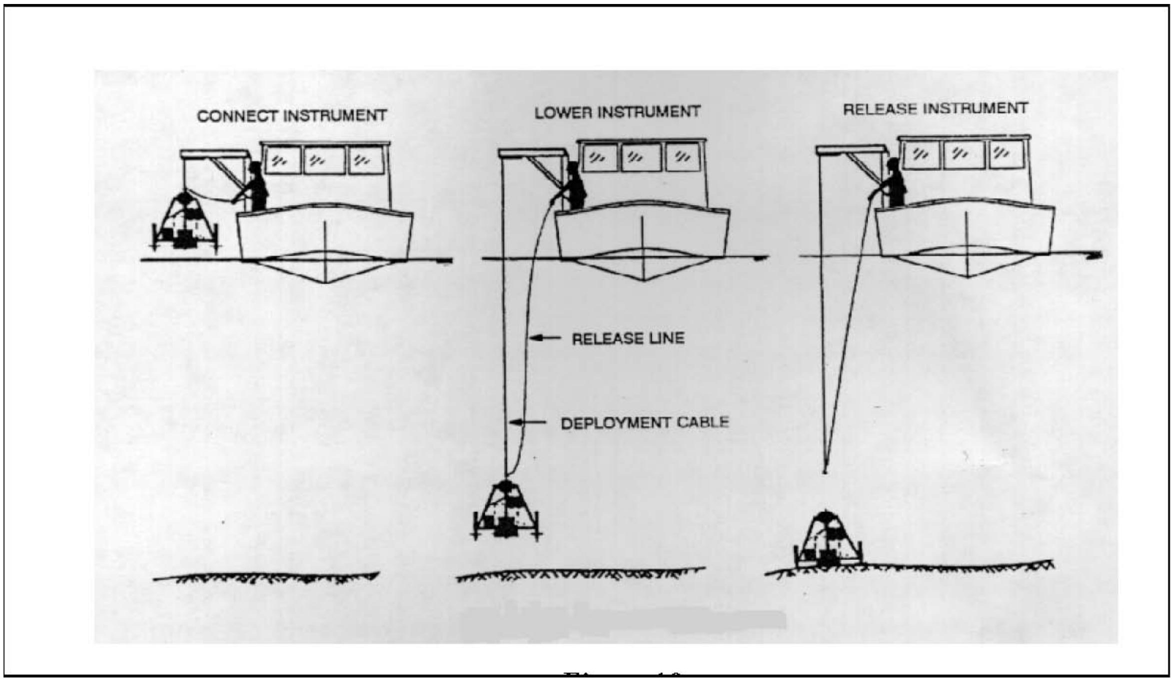


Figure 12. BFSD Deployment.

Recovery is accomplished by transmitting a coded acoustic signal to the frame-mounted receiver which in turn releases the marker buoy, Figure 13. As shown in Figure 14, the line attached to the buoy is used to lift the BFSD2 aboard the vessel. Stored sensor data is uploaded before the detaching cables.

Figure 13. Acoustic Release and Retrieval Buoy.

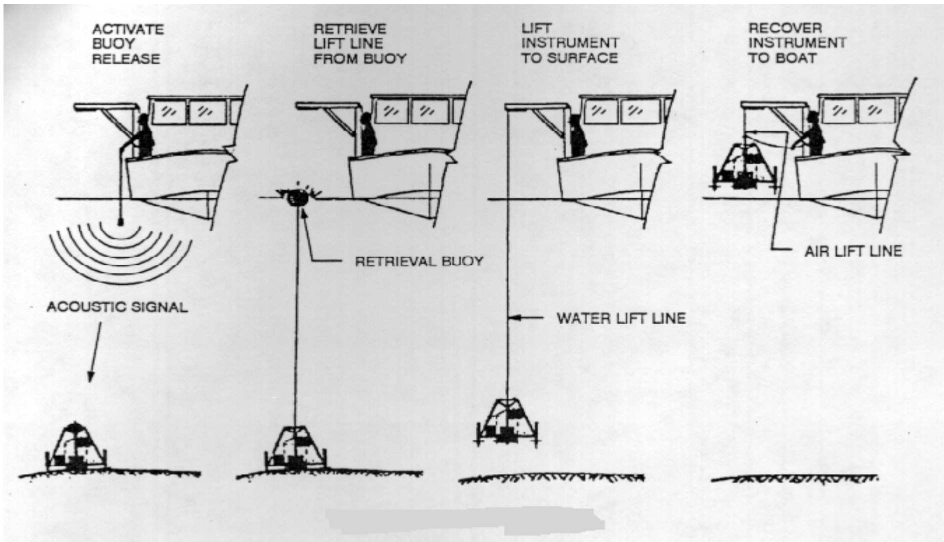


Figure 14. BFSD Retrieval.

2.1.7 Analytical Methods

2.1.7.1 Cleaning

Prior to each deployment, the BFSD2 sample collection system is cleaned and decontaminated. A sequential process of flowing cleaning fluids through the sampling subsystem using vacuum; of soaking disassembled parts (collection bottles and other parts) in prepared solutions; of physically brushing and rinsing the collection and sensor chambers and the circulation subsystem with prepared solutions is followed. For metals, a nitric acid soak/rinse is used before a final rinse with 18 meg-ohm de-ionized water and for organics a methanol rinse with air dry is used prior to sealing/closing off all paths of contamination until deployment.

2.1.7.2 Performance Indicators

A series of performance indicators are used to evaluate the data obtained during operational deployments. One performance indicator is the chemistry time-series data for silica. Silica, a common nutrient used in constructing the hard parts of some planktonic organisms, typically shows a continuous flux out of the sediments due to degradation processes. The linear increase in silica concentration with time in the collected sample bottles is therefore used as an internal check for problems such as a poor chamber seal at the lid or sediment surface. A field analytical test set (Hach Model DR2010) is used to assess the silica concentrations immediately following retrieval and before sending collected samples to the analytical laboratory. Figure 15 is an example of silica flux indicating an adequate chamber seal with the sediment. Also, with a good chamber seal the ongoing bacterial degradation of organic material in the sediment consumes oxygen (which must be regulated by the BFSD2) and also generates carbon dioxide. This gradually lowers the chamber pH and Figure 16 is an example of this data for a good chamber seal with the sediment.

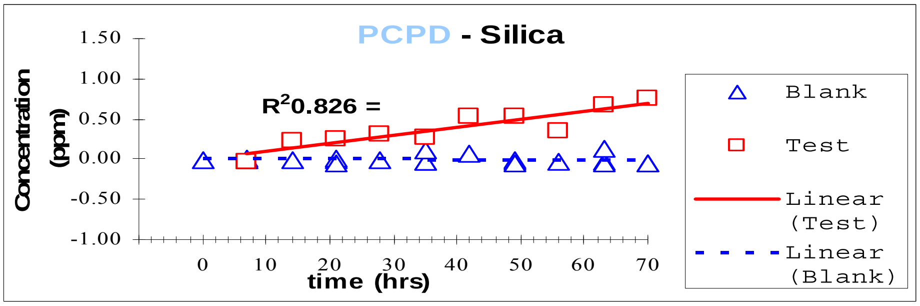


Figure 15. Silica Flux for Good Chamber Seal.

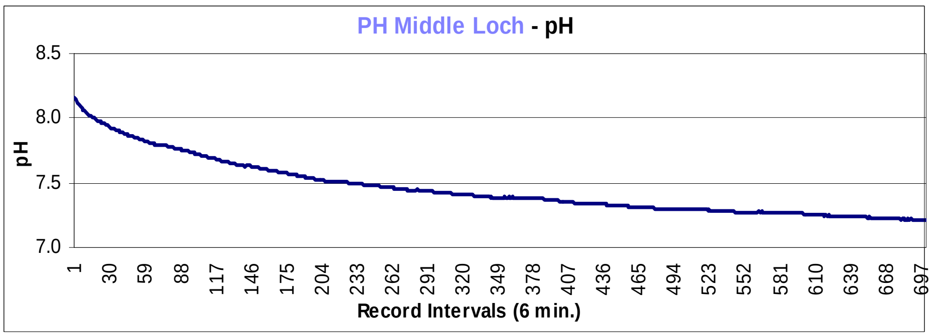


Figure 16. pH Data for Good Chamber Seal.

Although the expected relationships of these performance indictors aid in determining normal or successful deployments, natural variability is always present to cloud these relationships. Variations in the pore water reactions at the various sites lead to differences in the observed fluxes of oxygen, silica, and also the other contaminants. One major factor contributing to the large variations in fluxes may be burrowing activity. Enhanced biological irrigation (pumping of the overlying seawater through sediment burrows by infaunal organisms) increases the surface area of the sediment-water interface and flow rates across the interface, and may also increase the observed fluxes. The organisms responsible for this biological pumping will also affect oxygen uptake rates and may add to the complex interpretation of the analytical results.

2.1.7.3 Blank Tests

Prior to the BFSD2 demonstrations, a triplicate blank test was performed to determine the lower limit of resolution for flux determinations of various metals. A polycarbonate panel was sealed across the bottom of the chamber and the BFSD2 was lowered to within several meters of the sediment surface. A standard operational program identical to the demonstration deployments was run for 70 hours. The results will be presented later in this report.

2.1.7.4 Computations

Fluxes are computed from the trace metal concentrations in each sample bottle using a linear regression of concentration versus time after the concentrations are corrected for dilution effects. These dilution effects result from intake of bottom water from outside the chamber to replace the water removed for each collected sample. The corrected concentrations are obtained from the following equation:

$$\left[C_n\right] = \left[s_n\right] + \frac{v}{V}\left(\left(\sum_{i=1}^{n-1}\left[s_i\right]\right) - (n-1)\left[s_0\right]\right)$$

Where **[*C*]** is the corrected concentration, **[*s*]** is the measured sample concentration, ***n*** is the sample number (1 through 6), ***v*** is the sample volume, and ***V*** is the chamber volume. Fluxes are then calculated as follows:

$$Flux = \frac{mV}{A}$$

Where ***m*** is the slope of the regression of concentration versus time, ***V*** is the chamber volume, and ***A*** is the chamber area.

An interactive computational spreadsheet processes most data. Analytical laboratory results, sensor and other measured data, performance indicator results and blank test results are entered into the spreadsheet template and processed. A series of tables, charts and graphs are computed and displayed, including statistical confidence and other figures of merit. Appendix C provides a set of spreadsheet products for each demonstration.

2.2 Strengths, Advantages and Weaknesses

2.2.1 Strengths

The BFSD2 is an *in situ* technology. Benthic contaminant fluxes can provide a unique *in situ* measure of contaminated sediments as well as an indication of bioavailability. Many of the disadvantages cited for various approaches towards assessing sediment contamination relate to removal of the contaminated material to the laboratory for chemical and biological assays. In concert with traditional monitoring and assessment techniques, these flux measurements can lead to a better understanding of marine sediment contamination and transport mechanisms.

2.2.2 Advantages

The BFSD2 is an easily implemented technology, as it is readily deployed from a small boat, and all sampling, data logging, and control functions are carried out automatically based on preprogrammed parameters. The BFSD2 can be used to collect samples without diver assistance to minimize costs, time necessary for sampling, and safety issues associated with sampling activities. Furthermore, the system is able to collect a wide range of contaminants, nutrients, and dissolved gases and it is operational under a wide range of environmental conditions. All materials used in the system are suitable for use and prolonged exposure in the marine environment.

Results obtained using the BFSD2 can be used for the following purposes:

- Source quantification for comparison to other sources and input to models
- Indication of bioavailability since many studies indicate that resolubilized contaminants are more readily available for uptake
- Determination of the cleansing rate of a contaminated sediment site due to natural biogeochemical cycling of the in-place contaminants
- Provision of a nonintrusive monitoring tool for sites that have been capped or sealed to minimize biological exposure

- Testing and validation of hypotheses and models for predicting the response of marine sediments to various contaminants.

2.2.3 Weaknesses

One limitation is a lower limit on the flux rates that can be calculated from data collected using the BFSD2 system. Also, the BFSD2 may be deployed to a maximum depth of 50 meters and the maximum deployment is approximately 4 days, based on available battery capacity. The BFSD is stable in bottom currents up to 3 knots.

2.3 Factors Influencing Cost and Performance

2.3.1 Cost influences

The factors influencing cost include, in order:

1. Analytical laboratory costs: laboratory analysis of samples by highly specialized analytical laboratories accounts for approximately 50% of total BFSD2 project costs.

2. Blank tests: the larger the number of sites within a common bay, harbor or other defined location the smaller the proportional cost per site for blank tests. It may be possible to eliminate blank testing in some cases, but a cost approaching 50% could occur for only one deployment.

3. Remote location: Acquisition of local resources such as a surface vessel configured with a davit or A-frame and equipment shipping costs most influence total project costs. Transportation, per diem, materials and supplies are equivalent for all sites other than local. Labor costs are the same.

4. Work schedule: Limited site access or availability can influence cost. Without such restraints a work schedule taking advantage of *in situ* BFSD2 deployment periods over weekends and/or to accomplish cleaning, sample handling, and other turnaround preparations can be instituted. Extended work hours can be compensated with offsetting periods of inactivity.

2.3.2 Performance Influences

The factors influencing performance include:

1. Sediment physical conditions: The BFSD2 requires a collection chamber seal with the sediment to function properly. The primary cause for lack, or loss of seal is porosity of the sediment due to large grain size and distribution. An entire deployment can be lost under extreme conditions, however the use of performance indicators can avoid analytical laboratory costs by identifying such cases immediately after retrieval.

2. Sediment contamination levels: The lower limit for resolving significant flux levels is based on blank test results. Sites having contaminated sediment levels lower than blank test results cannot be resolved with a high degree of confidence. Such results are reported as statistical probabilities with confidence limits and are typically well below water quality limits and do not lead to cleanup issues.

3. Site marine conditions: As with 1. above (sediment-chamber seal), the BFSD2 also must also maintain a good chamber-lid seal. Surface vessel turbulence and/or prop wash, tidal and/or local currents, or even large fish disturbances can jar the magnetically held lid. A momentary loss of the lid seal can allow ambient seawater to enter the chamber and refresh sequestered sample water. Although such an event will be detected by the previously discussed performance indicators, some or all of the deployment can be negated by loss of lid seal.

3. Site/Facility Description

3.1 Background

Two locations were selected for BFSD2 demonstrations. The first was San Diego Bay, California (Paleta Creek area); and the second was Pearl Harbor, Hawaii (Middle Loch and Bishop Point). The locations/sites were selected based on the following criteria:

1. (metals) The sites were known to have metal-contaminated marine sediments, and had been at least partially characterized. The sediment contaminant levels were anticipated to be high enough to demonstrate statistically significant fluxes at the sediment-water interface.

2. (metals) Two deployments at the same San Diego Bay, Paleta Creek site would demonstrate repeatability; two deployments at geographically different Pearl Harbor sites would demonstrate characteristically different data and showcase analysis/interpretation results.

3. (metals) The contaminated sediments were located in shallow areas (less than 50 meters deep) and readily accessible.

4. (metals) Demonstration logistical support requirements would be demonstrated by deployments in Pearl Harbor.

5. (metals) Data from prototype BFSD deployments conducted at the Paleta Creek site were available for use as reference data and for comparison with demonstration results (See section 1.5).

6. (organics) Both sites were known to also have organics-contaminated sediments and other demonstration factors were already achieved.

3.2 Site/Facility Characteristics

3.2.1 San Diego Bay, California

With no major inputs of fresh water, the currents and residence time of water in San Diego Bay are tidally driven. The average depth of the bay is about 5 meters. The tidal range from mean lower-low water to mean higher-high water is about 1.7 meters. The maximum tidal velocity is about 0.05 to 0.1 meters per second. Sediment pore waters in San Diego Bay typically become anoxic several millimeters below the sediment surface. Dissolved oxygen concentrations range from 4 to 8 milliliters per liter; sea water pH varies from 7.9 to 8.1; and temperatures range from 14 to 25°C.

The sediments of San Diego Bay consist primarily of gray, brown, or black mud, silt, gravel, and sand. The sources of contamination in San Diego Bay have varied over time and include sewage, industrial wastes (commercial and military), ship discharges, urban runoff, and accidental spills. Current sources of pollution to San Diego Bay include underground dewatering, industries in the bay area, marinas and anchorages, Navy installations, underwater hull cleaning and vessel antifouling paints, and urban runoff. Known contaminants in the bay include arsenic, copper, chromium, lead,

cadmium, selenium, mercury, tin, manganese, silver, zinc, tributyltin, polynuclear aromatic hydrocarbons (PAH), petroleum hydrocarbons, polychlorinated biphenyls (PCB), chlordane, dieldrin, and DDT.

The Paleta Creek site, Figure 17, is located in San Diego Bay in San Diego County, California, adjacent to Naval Station San Diego. The Paleta Creek site is located on the western shore near Naval Station San Diego where Paleta Creek empties into the bay, slightly inland from the Navy Pier 8 and Mole Pier and north of Seventh Street. Naval Station San Diego began operations in 1919 as a docking/fleet repair base for the U.S. Shipping Board. In 1921, the Navy acquired the land for use as the San Diego Repair Base. From 1921 to the early 1940s, the station expanded as a result of land acquisitions and facilities development programs.

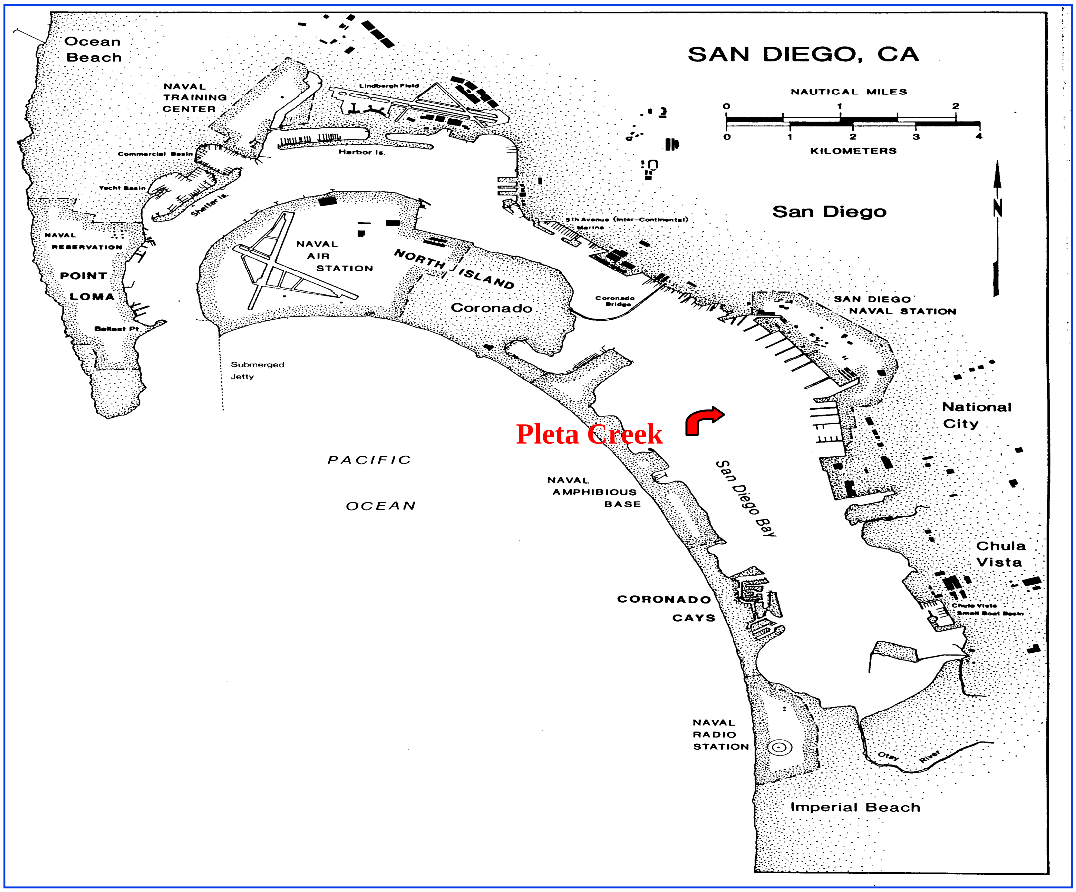


Figure 17. San Diego Bay, Paleta Creek Site.

3.2.2 Pearl Harbor, Hawaii

Pearl Harbor contains 21 square kilometers of surface water area; the mean depth is 9.1 meters. Tidal flow and circulation are weak and variable, with a mean tidal current velocity of 0.15 meter per second and a maximum ebb flow of 0.3 meters per second in the entrance channel. Salinity in Pearl Harbor ranges from 10 to 37.5 parts per thousand, with a yearly average of 32.8 parts per thousand. Harbor water temperatures annually range from 22.9 to 29.4°C, and dissolved oxygen values range from 2.8 to 11.0 milligrams per liter. Pearl Harbor is most appropriately described as a high-nutrient estuary.

Middle Loch is located in the northwestern end of Pearl Harbor, north and west of Ford Island, within the Pearl Harbor Naval Base, see Figure 18 below.

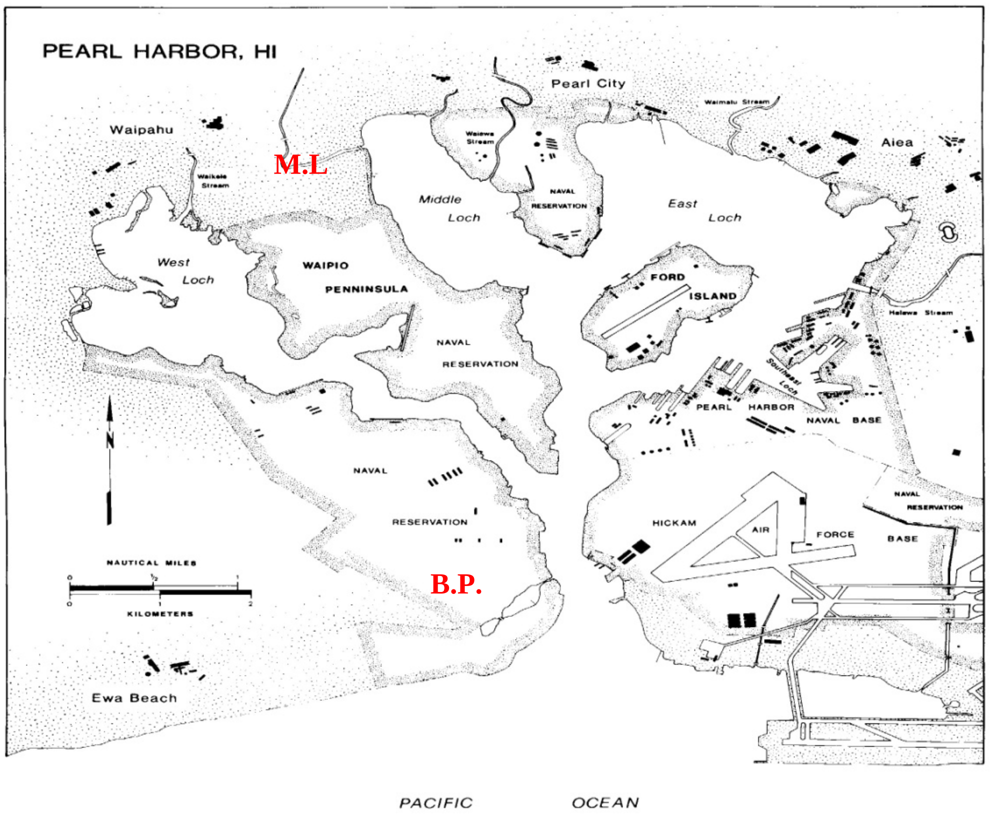


Figure 18. Pearl Harbor, Hawaii Middle Loch Bishop and Point Sites.

In 1901, the U.S. Navy acquired 800 acres of land to establish a naval station at Pearl Harbor. The Pearl Harbor Naval Base has existed since 1919. During World War I, about 12 warships were repaired and overhauled at the Navy Yard. In 1917, a temporary submarine base was relocated to the eastern shoreline of Southeast Loch. Industrial development in the vicinity of Pearl Harbor was greatly accelerated during the late 1930s and early 1940s. During the 1941 Japanese attack on Pearl Harbor during World War II, 21 of the U.S. ships in Pearl Harbor were sunk or severely damaged, and debris resulting from this attack remains buried in harbor sediments (despite initial cleanup efforts). Currently, Pearl Harbor is a major fleet homeport for nearly 40 warships, service-force vessels, submarines, and their associated support, training and repair facilities.

Middle Loch is moderately contaminated with heavy metals as well as with toxic organic compounds and hydrocarbons. Sediments contain various concentrations of metals such as silver, arsenic, cadmium, chromium, copper, iron, mercury, manganese, nickel, lead, and zinc. Toxic organic compounds include pollutants such as solvents, paints, pesticides, and PCBs. Hydrocarbon contaminants include all petroleum-based fuel products such as diesel, JP-5, JP-4, bunker fuel, gasoline, oils, sludges, and lubricants. Bishop Point is an active industrial area with ongoing salvage operations and related ship movements. Sediments contain similar contaminants as mentioned above but at higher levels.

4. Demonstration Approach

4.1 Performance Objectives

The demonstrations were intended to verify the performance of the BFSD2 by assessing whether chemicals are adsorbing to or desorbing from sediments at the sediment-water interface. Specifically, the objectives of the BFSD2 technology demonstrations were to:

(1) Evaluate the data quality of the water samples collected for use in determining if a statistically significant flux was occurring at the test locations.

(2) Evaluate the BFSD2 for repeatability.

(3) Evaluate the logistical and economic resources necessary to operate the BFSD2.

(4) Evaluate the range of conditions in which the BFSD2 can be operated.

In order to determine whether statistically significant fluxes were occurring at the test locations (Objective 1), 12 seawater samples were collected at 7-hour intervals using the BFSD2. For metals, the water samples were analyzed for cadmium, copper, manganese, nickel, lead, zinc and silica. For organics, the samples were analyzed for EPA priority PAHs, PCBs and pesticides. For metals, sediment samples, when collected, were analyzed for grain size, total solids, total organic carbon (TOC), acid volatile sulfide (AVS), simultaneously extracted metals (SEM), and total metals. Although the sediments may have been contaminated with other constituents, only the flux of the listed metals was evaluated during the demonstrations. For organics, sediment samples were analyzed for the same analytes as the associated water samples.

In addition, other metals including antimony, arsenic, selenium, silver, thallium, and iron were analyzed in the seawater samples collected during the three blank chamber tests. This data will be used at future dates when establishing baseline performance for these metals.

Sample concentrations were corrected for dilution introduced by the sampling process, and a regression curve was generated for each analyte based on the concentration data. Flux rates, with regression coefficients, were compared to the composite flux rate and standard deviation determined for each metal or organic during triplicate blank chamber tests. The measured flux rate for each metal or organic was then evaluated to assess if a statistically significant flux had been measured when compared to the blank chamber (background) test. The BFSD2 was evaluated for repeatability (Objective 2) by analyzing the metals results of repeat deployments, two weeks apart, at the same Paleta Creek site. Demonstration data was also compared to data from the site during previous prototype BFSD tests in the same approximate location. Finally, repeatability was evaluated by comparing the results from three blank chamber deployments for both metals and organics. The logistical and economic resources necessary (Objective 3) were evaluated by documenting costs associated with planning, scheduling and executing the demonstration deployments, laboratory analysis, data management, and report preparation. Lastly, the range of conditions for operating the BFSD2 were evaluated

(Objective 4) by describing the conditions under which the BFSD2 operated and the projected range of contaminants applicable to the technology.

The demonstration approach was to collect time series of water samples using the BFSD2 at two geographically different locations. For metals at the San Diego Bay location (Paleta Creek) two deployments at the same site were made; at the Pearl Harbor location, one deployment at each of two geologically different sites were made (Middle Loch and Bishop Point). Comparison of the results of the two Paleta Creek demonstrations to one another was intended to evaluate repeatability of the technology. Comparison of the results from the two geographically different sites in Pearl Harbor was intended to demonstrate data differences and analysis/interpretation approaches. Comparison of the Pearl Harbor data as a whole with that from San Diego also demonstrated geological differences between continental shelf and mid-Pacific riff measurements. For organics, one Paleta Creek deployment and one Bishop Point, Pearl Harbor deployment were performed to demonstrate the extended performance. For both metals and organics three "blank test" deployments were conducted, during which the BFSD2 was deployed in seawater with a sealed sampling chamber. Three time series of samples were collected and a baseline was established for each analyte, which provided a statistical estimate of the lower limit of flux detection measurable with the BFSD2. The data also served as another measure of precision and repeatability. Previous metals results obtained at the same location using the prototype BFSD also provided a general measure of trend repeatability. A rate of flux between the sediment and the water for each analyte for each deployment was calculated. The flux rate was calculated using knowledge of the volume of water enclosed within the BFSD2, the surface area of sediment isolated, the time the samples were collected, and the concentrations of the contaminants of interest in the individual sample. Because this technology has no current equivalent, the BFSD was evaluated based on the internal QA/QC of the laboratory analysis and an analysis of the data.

4.2 Physical Setup and Operation

4.2.1 Physical Setup

Deployment preparations included BFSD2 maintenance, decontamination and setup. Maintenance included inspection and repair due to leakage or corrosion, inspection of sealing surfaces, seals and o-rings, inspection and replacement of sacrificial zinc anodes, downloading and/or deleting unnecessary files in the memory-limited control and data acquisition subsystem, and inspection of any worn or other potentially failure prone areas.

Decontamination involves soaking and/or rinsing all surfaces contacting seawater samples in a series of fluids beginning with tap water, then de-ionized water, then a special detergent ("RBS"), then de-ionized water, then nitric acid for metals or Methanol for organics, then 18 meg-ohm de-ionized water (metals) and finally filtered air. For metals, the collection bottles are disassembled and all component parts are soaked, four-hours minimum, in each fluid. A 25% concentration of ultra-pure nitric acid is used to soak Teflon™ parts (bottles, lids, and sensor chamber) and a 10% concentration is used for all other parts (including acid-sensitive polycarbonate filter bodies). For organics, components are rinsed with Methanol and air-dried and precleaned amber-glass sample bottles are used. The synchronized rotary valves, tubes and fittings remain assembled to the BFSD2 and are cleaned in place by flowing the series of decontamination fluids through them. The acquisition and control subsystem is used to execute a special program which activates each valve position for specified time during which the decontamination fluids are forced through by positive pressure using a Teflon-coated pump. And finally, the collection chamber, lid, diffuser, circulation pump, tubes and fittings are physically scrubbed and rinsed in place with non-metallic brushes. All decontaminated surfaces are dried, reassembled or otherwise sealed to isolate them from ambient, air-borne contaminants.

BFSD2 setup includes various tasks to be performed prior to deployment using checklists. These include: charging the gel-cell 24Vdc battery; replacing the 14 circulation subsystem C-cell batteries; replacing the 6 acoustic release 9Vdc batteries; installing a new acoustic release subsystem burn wire, cleaning the plating anode and rigging the recovery float; checking and refilling (if required) the compressed-oxygen supply tank; checking the insertion light subsystem function and replacing its one battery (if required); installing the 12 sample collection bottles and evacuating them to less than 25 in-Hg; setting up laptop computer files for post-deployment data uploading; reviewing and modifying, as required, the deployment operational control programs and downloading the predrop program into the acquisition and control subsystem.

4.2.2 Deployment

Each BFSD deployment requires at least three personnel. One person is responsible for maneuvering, positioning and securing the surface vessel. Two additional persons are required to deploy and retrieve the BFSD. The checklists included in appendix D are the step-by-step procedures followed on deck to avoid oversights and mistakes. Ancillary tasks to be performed include collection of a sediment sample with a spring-loaded grab sampler and logging site GPS coordinates. Figures 19 through 22 illustrate typical deployment and recovery scenes.

4.2.3 Recovery

Recovery is initiated following an elapse time after the planned deployment greater than the operational program by at least two hours. This allows for accumulated processing delays which lengthen the overall autonomous time period. Once within approximately 100 yards of the deployment position a coded acoustic signal is transmitted to the BFSD2 acoustic receiver from the deck unit. A 15-minute function time begins during which the burn-wire is consumed and the recovery buoy is released. The line attached to the buoy is used to wench the BFSD2 and the attached coiled cables to the surface and aboard the vessel. Heavy sediment and other debris are washed off the BFSD2 before bringing it onboard. On deck an inspection of collection bottle status is made as an immediate indicator of deployment performance. Turning the compressed-oxygen cylinder valve off and installing storage caps on the pH and oxygen sensors is also done without delay. Other assessments that may be accomplished onboard include upload of logged data from the acquisition and control subsystem and processing of pH and oxygen sensor data as performance indicators. Spreadsheet templates are used to quickly generate graphs and charts of converted and processed data which display results for the entire operational deployment. Aboard a properly configured surface vessel such as SSC SD's R/V ECOS during the San Diego Bay demonstration sample handling such as acid preservation, labeling and sealing of 100 ml laboratory samples and 25 ml splits for measurement of silica concentration was accomplished. Once off loaded to shore, the BFSD2 must be thoroughly washed down with fresh water to remove all remaining debris, sediment and seawater and to minimize corrosion. As soon as practicable, a freshwater purge and forced-air dry of the synchronous rotary valves and associated tubes and fitting is accomplished.

Figure 19. Deployment Equipment **(**SSC SD Dock**).**

Figure 20. Crane Loading Aboard Workboat **(**Bishop Point, Pearl Harbor).

Figure 21 Deployment **(**Middle Loch, Pearl Harbor**).**

Figure 22. Recovery **(**Middle Loch, Pearl Harbor**).**

4.3 Sampling Procedures

The sampling procedures followed for the BFSD2 demonstrations provided assurance that the overall project goals and objectives were met. Careful adherence to the procedures ensured that data collected was useful in evaluating the effectiveness of the BFSD2 for benthic flux measurements.

4.3.1 Overview of Sampling Operations

Sampling operations at each demonstration location consisted of site deployments during which the BFSD2 collected seawater samples at timed intervals and a sediment confirmation sample collected following each site deployment. Three additional identical blank (background) deployments with the BFSD2 collection chamber sealed using a polycarbonate bottom plate were used to statistically establish system blank performance as a baseline for comparison to the sediment flux data.

4.3.1.1 BFSD2 Sampling

Samples were collected *in situ* in twelve 250-ml precleaned sampling bottles at preprogrammed time intervals. A description of the sampling technology can be found in Section 2.1. Sampling was initiated by starting the acquisition and control subsystem program, which activated synchronous rotary valves connected to the sample bottles. In-line filters passed only seawater with dissolved-phase contaminants at the time of collection. After each deployment, the samples for metals analysis

were transferred to appropriate sample containers and acidified, if necessary. Samples for organics analysis were collected in non-reusable bottles and shipped to the analytical lab without further disturbance. A baseline ambient water sample was collected as the number one BFSD2 sample during deployment. The sample was analyzed and used to establish the ambient concentration at time zero for each analyte. The total time required for the 12 sampling events including the time zero sample using 7-hour intervals was approximately 72 hours with consideration for accumulated data processing delays.

4.3.1.2 Sediment Sampling

A sediment sample was collected at the end of each different site deployment using a spring-loaded grab sampler. The sediment was containerized, capped, labeled, and sealed. The sediment samples were used in various analyses, including digestion and extraction processes to measure trace metal and organic levels. Other measurements related to seawater data analysis and interpretation were conducted and are reported in a later section.

4.3.1.3 System Blank Samples

With the BFSD2 configured as described in Section 2.1, three deployments using identical procedures were accomplished for both metals and for organics. The samples were collected and handled as in the demonstrations (see 4.3.1.1 above) and shipped to the analytical laboratory for the analyses discussed below.

4.3.1.4 Quality Control

Demonstration samples and blank samples included equipment blanks, trip blanks and laboratory blanks to assess the performance of the equipment in the field.

4.3.1.5 Communications and Documentation

The SSC SD program manager communicated regularly with demonstration participants to coordinate all field activities associated with the demonstrations and to resolve any logistical, technical, or QA issues that arose as the demonstrations progressed. Successful implementation of the demonstrations required detailed coordination and constant communication among all participants. Field documentation was included in field logbooks, field data sheets, chain-of-custody forms, and kept in a bound logbook. Each page was sequentially numbered and labeled with the project name and number. All photographs were logged by the digital camera and transferred to the computer file system. Those entries included the time, date, orientation, and subject of the photograph. Specific notes about each sample collected were written on sample field sheets and in the field logbook. Any deviations from the approved final demonstration plan were thoroughly documented in the field logbook and communicated to parties affected by the change. Original field sheets and chain-of-custody forms accompanied all samples shipped to the laboratory.

4.3.1.6 Field Sample Collection

Sampling personnel collected and prepared samples using the procedures described below. All field activities conformed with the requirements of the Demonstration Plan and its attached Health and Safety Plan. Sampling operations at each site consisted of a deployment of the BFSD to collect seawater samples at timed intervals, and collection of a sediment grab sample after deployments. The series of samples collected during three blank test deployments with the chamber sealed with a polycarbonate bottom were used to assess the background level from which statistically significant fluxes can be derived.

4.3.1.6.1 Field Blanks

One field blank for the San Diego Bay metals demonstration consisted of an additional 250-mL bottle filled with de-ionized water strapped to the flux chamber. This sample was to be used to assess the integrity of the sample bottle seals if anomalous data are obtained.

4.3.1.6.2 Equipment Blanks

These samples consist of running 250 ml of de-ionized water through the BFSD2 sampling subsystem prior to deployment. One equipment blank was collected for each site demonstration. The equipment blank was used as a quality control measure to ensure that the BFSD2 was properly decontaminated between deployments.

4.3.1.6.3 Trip Blank

. One trip blank for the San Diego Bay metals demonstration was collected by placing a closed 250-ml sample of de-ionized water in a sample cooler at the beginning of the demonstration. The trip blank was used as a quality control measure, if necessary, to ensure that samples are not contaminated during sample storage and shipment to the laboratory.

4.3.1.6.4 Silica

Confirmatory silica analysis was used for metals tests to ensure that the BFSD2 is functioning properly, without any significant loss of collection chamber seal. Silica is a common component in constructing the hard parts of some planktonic organisms, and it typically fluxes out of sediments at a constant rate due to dissolution processes. By analyzing each of the samples collected using the BFSD for silica and plotting the concentration versus time data, a linear increase in silica concentration over time strongly suggests that there was a good seal of the chamber with the sediment. The first sample at time zero provides a value for silica in bottom waters at the start of the experiment. The silica analysis was performed using 25 ml of seawater removed from each sample collected prior to acid preservation. To maximize sample volume for organics analysis, measured pH data was used to ensure chamber seal integrity.

4.3.1.6.5 BFSD2 System Blanks

Finally, for metals, a triple-duplicate deployment with the collection chamber sealed with a polycarbonate bottom ("blank test") was conducted as an experiment blank at the SSC SD dock in San Diego Bay. The data collected during those deployments provided a baseline with which to compare the site-specific flux rates, in order to document a statistically significant flux rate from both analytical and system variability in a seawater environment. For organics, a triplicate set of blank tests were conducted "*ex-situ*" using a single supply of ambient seawater. The data collected provided less variability due to the constant seawater supply, including sample makeup volumes.

4.3.1.7 Laboratory Blanks

Laboratory Blanks and Laboratory QC checks are designed to assess the precision and accuracy of the analysis, to demonstrate the absence of interferences and contamination from glassware and reagents, and to ensure the comparability of data. Laboratory QC checks consist of laboratory duplicates, surrogates, MS/MSDs, and method blanks. For organics, a Method Detection Limit study was performed to establish modified EPA standard procedures and controls for targeting specific PAHs, PCBs and pesticides with small sample volume. No comparable MDL study was performed for metals because adequate volumes were collected from the chamber for EPA standard procedures in which detection limits were adequate to measure anticipated metals concentrations.

4.3.1.7.1 Method Blanks

Method blanks were used to verify that preparation of samples was contamination-free. Each batch of extracted and digested samples was accompanied by a blank that was analyzed in parallel with the rest of the samples, and carried through the entire preparation and analysis procedure. Method blanks may also be called calibration blanks. Calibration blanks are analyzed for seawater samples analyzed for metals, for seawater samples analyzed for silica, for sediment samples analyzed for metals, and for sediment samples analyzed for SEM.

4.3.1.7.2 Precision

Analytical precision and method detection limits are determined by replicate storage, preparation, and analysis of standard seawater. Further verification of precision is achieved by splitting 1 in 20 field samples. Laboratory duplicates are analyzed during analysis of water samples analyzed for metals, water samples analyzed for alkalinity (if performed), sediment samples analyzed for metals, and sediment samples analyzed for SEM.

4.3.1.7.3 Accuracy

Spiked replicates of field samples were processed with each analytical batch to validate method accuracy within the context of varying matrices. With water and extracted water samples that are analyzed by the method of standard additions, spiked samples are not used. MS and MSD samples were used for analysis of water samples analyzed for metals, sediment samples analyzed for metals, sediment samples for AVS, and sediment samples for SEM.

4.3.1.8 Sample Storage, Packaging, and Shipping

The field team followed chain-of-custody procedures for each sample as it was collected following BFSD2 retrieval. An example chain-of-custody form can be found in Appendix E. The following information was completed on the chain-of-custody form: project number, project name, sampler's name, station number, date, time, station location, number of containers, and analysis parameters.

Following retrieval and removal of the samples from the BFSD at the end of each single deployment, and until shipment to Battelle (metals) or Aurther D. Little (organics), all samples were stored in refrigerators or coolers and maintained with ice at a temperature of approximately 4 $^{\circ}$C. The custody of samples was maintained in accordance with standard operation procedures (SOP). Samples to be shipped to the confirmatory laboratory were packaged and shipped according to the sample packaging and shipment requirements SOP. Copies of these SOPs are available upon request.

4.4 Analytical Procedures

4.4.1 Selection of metals Analytical Laboratory

The analytical laboratory selected to provide analytical services is Battelle Marine Sciences Laboratory (Battelle). Battelle was selected because of its experience with QA procedures, analytical result reporting requirements, and data quality parameters. Battelle is not affiliated with SSC SD or any of the demonstration team members.

4.4.2 Metals Analytical Methods

Sample and data analysis are key elements in the use of samples collected by the BFSD. Samples were analyzed for metals including cadmium, copper, lead, manganese, nickel, and zinc; and silica. The seawater samples collected by the BFSD2 and marine sediment samples were sent to Battelle for analysis. The analytical methods that were used are listed in Table 1. In addition, other metals

including antimony, arsenic, selenium, silver, thallium, and iron, were analyzed in the seawater samples collected during the three blank chamber tests. This data will be used in future projects to establish baseline data for the metals.

Table 1. Analytical Methods.

ANALYTE	SEAWATER SAMPLE	SEDIMENT SAMPLE
	Analytical Method	**Analytical Method**
Cadmium	ICP-MS (Nakashima et al. 1988)	GFAA (Crecelius et al. 1993)
Copper	ICP-MS (Nakashima et al. 1988)	XRF (Crecelius et al. 1993)
Iron	GFAA (Crecelius et al. 1993)	XRF (Crecelius et al. 1993)
Manganese	ICP-MS (Nakashima et al. 1988)	XRF (Crecelius et al. 1993)
Nickel	ICP-MS (Nakashima et al. 1988)	XRF (Crecelius et al. 1993)
Lead	ICP-MS (Nakashima et al. 1988)	XRF (Crecelius et al. 1993)
Zinc	ICP-MS (Nakashima et al. 1988)	XRF (Crecelius et al. 1993)
Miscellaneous Metals - Antimony, Arsenic, Selenium, Silver, and Thallium	ICP-MS (Nakashima et al. 1988) GFAA or XRF (Crecelius et al. 1993)	N/A
Silica(1)	Strickland and Parsons 1968	N/A
Alkalinity	Strickland and Parsons 1968	N/A
Grain Size	N/A	(Plumb 1981)

Total Solids	N/A	(Plumb 1981)
Total Organic Carbon	N/A	(Plumb 1981)
Acid Volatile Sulfide	N/A	(Lasorsa and Casas 1996)
Simultaneously Extracted Metals	N/A	ICP-MS (EPA Method 1638)

N/A – Not Applicable
ICP-MS – Inductively coupled plasma mass spectroscopy
XRF – X-ray florescence
GFAA – Graphite furnace atomic absorbtion\
(1) Silica was analyzed in the field using a HACH DR 2010 instrument to assure sample integrity and to determine whether samples will be sent to the laboratory for full analysis.

4.4.2.1 Preconcentration

The preconcentration method used for this project (Nakashima et al. 1988) was a tetrahydroborate reductive precipitation as a preconcentration technique. Samples were first acidified with nitric acid to pH 1.8 for storage. Samples were then adjusted to pH 8 to 9 with high-purity ammonia solution and iron and palladium were added. A sodium tetrahydroborate solution was added before the solution was filtered through a 25-millimeter (mm) -diameter acid-washed, acid-resistant cellulose nitrate 0.45-micrometer membrane filter. Concentrated nitric and hydrochloric acids are added to the empty bottle to dissolve any precipitate adhering to the walls; the acid mixture was subsequently transferred to the filter assembly. The filter is washed with water, and the solution was diluted to 25 ml. The filter and its holder were rinsed with 3-ml aliquots of the nitric and hydrochloric acids and water between samples, and were used repeatedly. The combination of iron and palladium brought about the rapid formation of a precipitate after the addition of sodium tetrahydroborate.

4.4.2.2 Inductively Coupled Plasma Mass Spectrometry (Nakashima et al. 1988)

ICP-MS analysis allows the simultaneous, multi-elemental determination of metals by measuring the element-emitted light by optical spectrometry. Element-specific atomic-line emission spectra are dispersed by a grating spectrometer, and the intensities of the lines are monitored by photomultiplier tubes.

4.4.2.3 Graphite Furnace Atomic Absorption (Nakashima et al. 1988)

GFAA allows the individual analysis of iron, arsenic, lead, selenium, and thallium to provide lower detection limits. In the furnace, the sample is evaporated to dryness, charred, and atomized. A light beam from a hollow cathode lamp or an electrode-less discharge lamp is directed through the tube into a monochromator and onto a detector that measures the amount of light. Because the wavelength of a light beam is characteristic of a single metal, the light energy absorbed is a measure of that metal's concentration.

4.4.2.4 Silica (Strickland and Parsons 1968)

The sea water sample was allowed to react with molybdate under conditions which result in the formation of the silicomolybdate, phosphomolybdate, and arsenomolybdate complexes. A reducing solution, containing oxalic acid, is then added which reduces the silicomolybdate complex to give a blue reduction compound and simultaneously decomposes any phosphomolybdate or

arsenomolybdate, so that interference from phosphate and arsenate are eliminated. The extinction of the resulting solution was measured using 25centimeter (cm) cells. This method was performed using a Hach Model DR2010 Field Kit prior to sending samples to the laboratory.

4.4.2.5 Sediment Samples

Sediment sample analysis included methods to determine grain size, TOC, AVS and total metals. The collected sediment samples were homogenized and split into subsamples before analysis. Sediment samples for total metals analysis were freeze-dried and ground prior to analysis. Total metals were then determined using X-ray fluorescence (XRF) or GFAA (Crecelius et al. 1993).

4.4.2.5.1 Grain Size (Plumb 1981)

Grain size was measured by a combination of sieving, particle counters, and pipette analysis, as described in the above reference.

4.4.2.5.2 TOC (Plumb 1981)

TOC was measured on an automated carbon analyzer by measuring total carbon and inorganic carbon contents, with the difference providing the TOC values. Inorganic carbon from carbonates and bicarbonates were removed by acid treatment. The organic compounds were decomposed by pyrolysis in the presence of oxygen or air.

4.4.2.5.3 X-ray Fluorescence (Crecelius et al. 1993)

This procedure uses energy dispersive x-ray fluorescence spectroscopy to quantify elemental concentrations in sediment and tissue samples.

4.4.2.5.4 AVS (Lasorsa and Casas 1996)

AVS is operationally defined as the fraction of sulfide present in the sediment that is extracted with cold hydrochloric acid. Analysis of AVS is an indicator of potential metal toxicity in sediments. AVS was determined by photoionization detection (PID) following a step that converted the sulfide in the sample to hydrogen sulfide. During the first step, the sample was allowed to react with 1 N hydrochloric acid, the system was purged with purified inert gas, and produced hydrogen sulfide was trapped using a column immersed in liquid nitrogen. The PID method used gas chromatographic separation and photoionization detection; the area under the curve of the chromatograph was used to calculate sulfide concentration from the linear regression of the standard curve.

4.4.3 Selection of Organics Analytical Laboratory

Arthur D. Little Analytical Laboratory, Cambridge, MA was selected for organics analysis as a result of a successful Method Detection Limit study to optimize detection limits for selected PAHs, PCBs and pesticides form 250 ml seawater samples. The resulting EPA-based procedures and controls were documented and used for all subsequent analyses.

4.4.4 Organics Analytical Methods

See Appendix C for a complete description of the Method Detection Limit study and organic sample analysis procedures and controls.

4.4.5 Data Reduction and Analysis

Correction of concentration for dilution, regression analysis, and flux rate concentrations were calculated using a custom spreadsheet template. See Appendix D for a complete set of spreadsheets for both metals and organics. Results from these complex computations require careful analysis and interpretation to reach valid conclusions. Various other sitespecific data and information must be used in combination with computed flux results to fully interpret the data. The approach taken and the conclusions reached for the demonstrations of this report are presented in the next section.

5. Performance Assessment

5.1 Performance Data

5.1.1 Metals Blank Tests

The primary purpose for performing system blank tests was to establish BFSD2 minimum performance levels, or detection limits, for assessment of flux data obtained during subsequent demonstration tests. Three replicate 70-hour blank tests were conducted using BFSD2 between May 14 and 31, 1998. The tests were conducted from the end of SSC, San Diego Pier 159 at approximately two feet off the bottom in seawater ranging from about 14 to 20 feet deep, depending on tidal flow.

As discussed earlier, the BFSD 2 collection chamber bottom was sealed with a polycarbonate plate and filled with ambient seawater at the start of each 70-hour test. Prior to each test routine procedures for decontamination of the sampling system were performed. Equipment and source blanks were taken. After each test the samples were handled in accordance with EPA Methods 1638 and 1669 and routine chain of custody procedures were used in preparation and shipment to Battelle Marine Sciences Laboratory for analysis. The Silica samples were sent to and analyzed by Scripps Institute of Oceanography.

Each test produced twelve 250ml sample bottles of seawater filtered *in situ* to 0.45 micron. Sample bottle one in each test was filled with ambient seawater taken from the water column as the BFSD 2 was lowered to its test depth at about 15 feet below the surface. Sample bottle two in each test was filled with seawater from the sealed chamber at 6 minutes after start of the 70-hour test. The remaining 10 sample bottles were filled from the chamber at 7-hour intervals. The data, analysis and graphs for each test were processed and compiled in Microsoft Excel spreadsheet, "BFSD2 Blank Tests.xls", provided with the electronic submission of this report. Appendix C provides copies of the spreadsheet results and includes data and graphs for the BFSD2 flow-through sensors. Table 2 below is a summary of the results of the blank tests

Table 2. Metals Blank Test Results Summary.

Metal	Blank Flux ($\mu g/m^2/day$)			Repeatability ($\mu g/m^2/day$)		
	Test 1(12)	Test 2 (6)	Test 3 (6)	Average Flux	+/- 95% C.L.	Std. Deviation
Copper (Cu)	25	-13	15	2.82	8.73	19.7
Cadmium (Cd)	-5.3	-0.8	-0.09	-0.52	0.75	2.8
Lead (Pb)	2.8	5	1	3.16	1.59	2.0
Nickel (Ni)	23	20	-6.7	10.28	7.34	16.4
Manganese (Mn)	-289	-249	-250	-264.85	7.49	22.8
Zinc (Zn)	-194	-13	200	-3.38	-68.61	197
Silica (SiO_2)* (*mg/m2/day)	-4	-3.3	1.4	-1.97	2.88	2.9

5.1.1.1 Discussion of Metals Blank Results

As expected, the blank results for most metals showed little or no time trend, indicating minimal source or loss of target analytes during the blank experiments. Figures 23 through 29 provide graphs of concentration versus time for each analyte for each blank test. With the exception of lead and manganese, replicate analysis indicates that none of the metal fluxes were significantly different from a zero flux condition at the 95% confidence level. Copper results for the three replicates showed both small positive and small negative flux rates. Replicate blanks for cadmium were all small and negative, however the variability was sufficient that the mean was still not significantly different than zero. Results for lead indicated small positive flux rates with a mean value of 2.9 $\mu g/m^2/day$ which was different from the zero flux condition, suggesting a potential small source of lead in the experimental procedure. Nickel results indicated small positive and negative fluxes with no obvious uptake or sources of nickel from the system. Replicates for manganese all showed substantial negative flux rates indicating a significant loss of manganese due to some aspect of the experimental procedure. Results for zinc showed both positive and negative fluxes with no clear pattern of source or uptake.

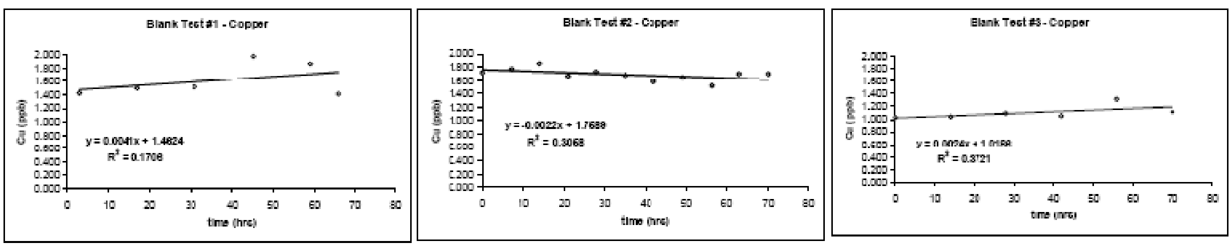


Figure 23. Blank Performance for Copper (Cu**).**

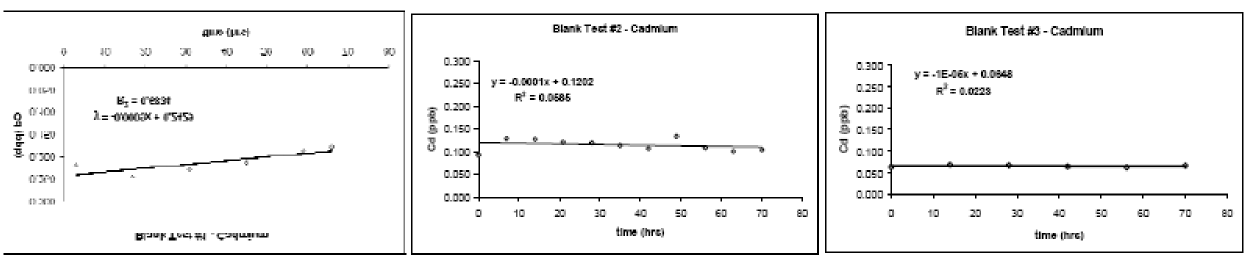


Figure 24. Blank Performance for Cadmium (Cd**).**

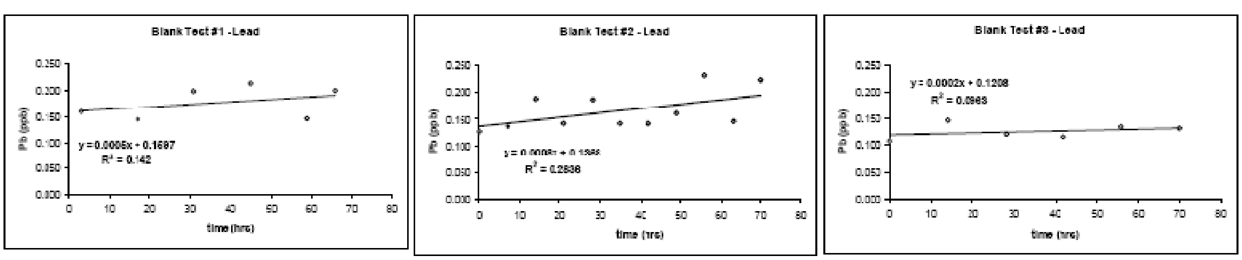


Figure 25. Blank Performance for Lead (Pb**).**

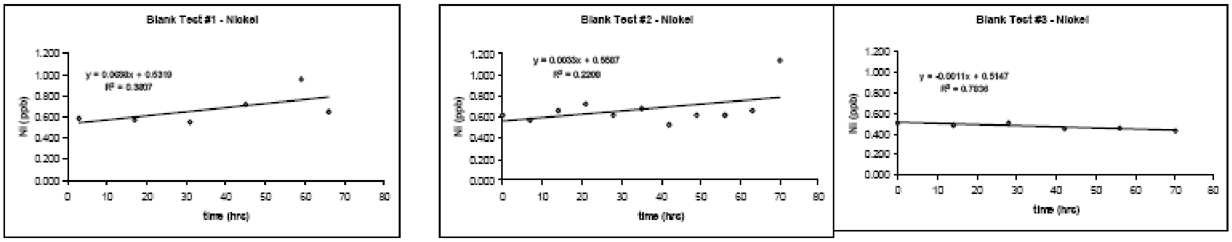


Figure 26. Blank Performance for Nickel (Ni**).**

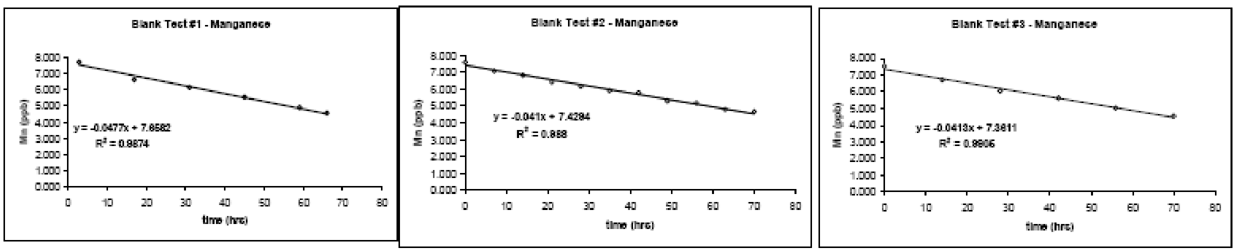


Figure 27. Blank Performance for Manganese (Mn**).**

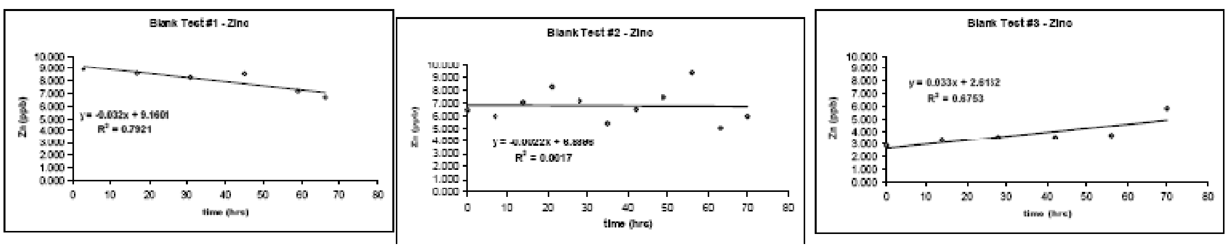


Figure 28. Blank Performance for Zinc (Zn**).**

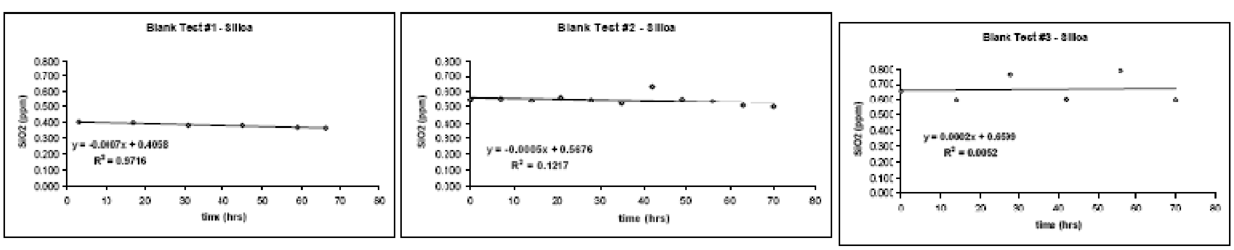


Figure 29. Blank Performance for Silica (Sio_4**).**

Scripps Institute of Oceanography analyzed silica concentrations, used to indicate chamber integrity and seal. The CA EPA request for an independent analysis of Silica could not be reasonably obtained from Battelle. Subsequent silica analyses were conducted on-site with field analytical systems (i.e., Hach Kit).

Results show a high, very repeatable level of Manganese uptake by the BFSD2. Results from earlier prototype BFSD blank tests were not consistent with this result and further investigation

is warranted. However, because manganese is not generally viewed as a toxic metal, the resolution of this issue is less critical than for other metals.

The somewhat higher blank fluxes observed for zinc are consistent with previous results and are attributed to the ubiquitous nature of zinc and associated contamination during sampling and analysis. Because previously measured flux rates for zinc generally lie outside the range of these blanks, and because of the higher toxicity thresholds for zinc relative to other metals, this is not considered as a serious problem. However, as with all trace metals, care must be taken to minimize zinc contamination during all phases of the experimental procedure. The higher variability between the zinc blank tests will make any results indicating small fluxes of zinc from sediments less conclusive.

5.1.1.2 Discussion of Metals Blank Tests

Although the three blank tests were reasonably trouble free and produced generally high quality data there are a number of points deserving further discussion and explanation.

5.1.1.2.1 Sensors

The flow-through sensors for dissolved oxygen and for pressure, Figures 30 and 31, produced data requiring explanation. The "noisy" dissolved oxygen data was discovered to be due to restricted flow over the sensing element. Flow improvements resolved the problem prior to the Paleta Creek demonstrations (see Figure 35). The oxygen measurements during the blank test are not critical because there is little oxygen depletion when no sediment is present. Drift of the pressure sensor readings was more problematic and resolution required trouble shooting at the factory, after the Paleta Creek demonstrations.

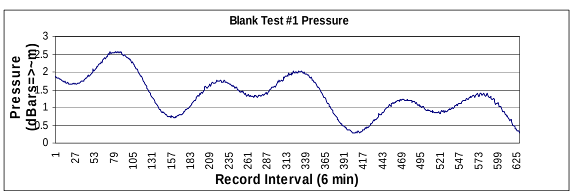


Figure 30. Blank Test Dissolved Oxygen.

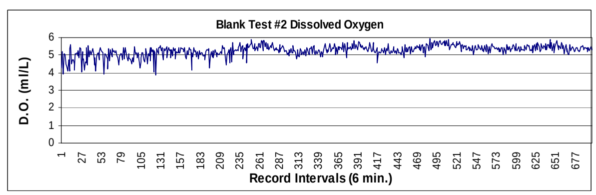


Figure 31. Blank Test Pressure.

5.1.1.2.2 Ambient Seawater Sample

Sample bottle one was not used in blank test analyses, as well as subsequent Paleta Creek demonstration analyses. Analytical laboratory results clearly indicate that the metal concentrations in the water collected in bottle one as the BFSD2 descended to the test depth were not consistent with concentrations in the chamber after it was closed and sealed at the surface prior to descending to the test depth. CA EPA certification evaluators agreed that the sample taken at 6 minutes after the start of the test was a better representation of replacement water entering the chamber. The unused concentration value is still shown, in bold, in the spreadsheet. A sensitivity analysis of the affect of this change on dilution correction calculations and subsequent flux results show it to be insignificant. Consequently, an improved method to fill sample bottle one from more representative bottom water was implemented.

5.1.1.2.3 Metals Sample Analysis

Not all samples were analyzed to minimize analytical costs. For Blank Test 1 only the six odd-numbered samples were analyzed (with further changes, see next paragraph); for Blank Test 2 all

twelve samples were analyzed; for Blank Test 3 only the six even-numbered samples were analyzed. Also, additional trace metals beyond those identified for CA EPA certification evaluation were analyzed for future applications.

Blank Test 1 suffered a “False Start” when an error in a software control loop shut the test down after six minutes, following sample bottle two filling. The error was corrected from the surface and the test was restarted three hours later without raising the BFSD2 from the test depth. Sample bottle three filled immediately upon restart and sample bottle two was retained as representative of ambient conditions. To complete the set of six samples, sample bottle twelve with a 7-hour interval was added to the other odd-numbered samples. Blank Test 1 was 66 hours total duration.

5.1.1.3 Metals Blank Tests Assessment

It was concluded that the BFSD2 metals blank performance was statistically established and the values obtained were repeatable, precise and accurate enough to allow valid measurement of *in situ* sediment flux rates.

5.1.2 Organics Blank Tests

Three replicate 70-hour blank tests were conducted using BFSD2 between September 1, 2000 and November 27, 2000. The purpose of the tests was to establish system performance levels for selected polynuclear aromatic hydrocarbons (PAH) using standardized procedures as part of the demonstration project. Performance levels for selected polychlorinated biphenyl (PCB) congeners and pesticides were also measured for future potential applications. As shown in Figure 32, the tests were conducted *ex situ* at SSC San Diego using Naval Station San Diego (Paleta Creek) seawater.

Figure 32. *Ex Situ* BFSD2 Organics Blank Test Physical Setup.

The BFSD 2 collection chamber bottom was sealed with a polycarbonate plate and filled with seawater collected from the Paleta Creek industrial area within Naval Station San Diego, at the start of each 70-hour test. Paleta Creek has been designated as a “toxic hotspot” by the Regional Water Quality Control Board and has been selected for the initial demonstration of BFSD 2 for organics applications. Makeup seawater to replace collected sample volume and any leakage was likewise the same Paleta Creek source seawater. Prior to each test, routine procedures for decontamination of the sampling system were performed. The procedure differed from that used in metals applications only in that the Nitric acid rinse was omitted and a final Methanol rinse

was added. Samples were collected into 250ml precleaned amber glass sample bottles fitted with custom inline filter assemblies (Figure 6b). The filter element was a 47mm Gelman 1.0-micron binder-less borosilicate glass filter prepared by pre-combustion for 24 hours at 375 degrees Fahrenheit. The samples were collected, capped, labeled and shipped in the same commercially standard sample bottle. Routine chain of custody procedures were used for overnight shipment to Arthur D. Little, Inc. (ADL) analytical laboratory in Cambridge, MA. All samples were collected, shipped (chilled to 4 degrees), received and extracted within the EPA seven-day hold time requirement. Laboratory processing and analysis of the samples was in accordance with EPA SW-846 methods and procedures, including Methods 8270M and 8081A protocols modified based on results from a Method Detection Limit study performed under contract N66001-96-D-0050 by ADL for this project.

Each test produced twelve filtered 250ml (approximately) samples and one additional 500ml unfiltered source sample. Sample bottle one in each test was filled with source seawater passed through the chamber lid closure-activated valve at the initiation of the 70- hour test. Sample bottle two in each test was filled with seawater from the sealed chamber approximately 6 minutes after chamber lid closure. The remaining 10 sample bottles were filled from the sealed chamber at 7-hour intervals. The 500ml unfiltered sample was taken from the residual source seawater container at the conclusion of the test. Table 3, 4 and 5 are summaries of the results of the organics blank tests.

Table 3. PAH Blank Tests Results Summary.

PAH	Blank Flux (ng/m^2/day)			Repeatability (ng/m^2/day)		
	Test 1	Test 2	Test 3	Average Flux	+/- 95% C.L.	Std. Deviation
1. Naphthalene	-243.5	-448.1	-629.3	-440	218.4	193.0
2. Acenaphthene	-32.4	ND	ND	-32.4	n/a	n/a
3. Acenaphthylene	-350.2	141.0	275.9	22.2	372.9	329.5
4. Fluorene	125.5	-69.3	-84.2	-9	132.4	117.0
5. Phenanthrene	89.0	-39.8	-16.3	11	77.6	68.6
6. Anthracene	182.3	53.1	-324.8	-30	298	263
7. Fluoranthene	-421.5	-1539.0	-1308.9	-1089.8	667.8	590.1
8. Pyrene	76.6	-447.1	-431.9	-267.5	337.3	298.0
9. Benzo(a)anthracene	ND	ND	ND	n/a	n/a	n/a
10. Chrysene	23.9	-61.9	ND	-19.0	84.2	60.7
11. Benzo(b)fluoranthene	ND	ND	-134.3	-134.3	n/a	n/a
12. Benzo(k)fluoranthene	ND	ND	-9.8	-9.8	n/a	n/a
13. Benzo(a)pyrene	ND	ND	ND	n/a	n/a	n/a
14.Indeno(1,2,3-c,d)pyrene	ND	ND	ND	n/a	n/a	n/a
15. Dibenz(a,h)anthracene	ND	ND	ND	n/a	n/a	n/a
16. Benzo(g,h,I)perylene	ND	19.6	ND	19.6	n/a	n/a

Table 4. PCB Blank Test Results Summary.

PCB	Blank Flux ($ng/m^2/day$)			Repeatability ($ng/m^2/day$)		
	Test 1	Test 2	Test 3	Average Flux	+/- 95% C.L.	Std. Deviation
(8) 2,4'-Dichlorobiphenyl	-66.6	ND	47.8	-9.4	112.2	80.9
(18) 2,2',5-Trichlorobiphenyl	205.2	23.3	27.0	85.2	117.6	104.0
(28) 2,4,4'-Trichlorobiphenyl	-8.0	ND	ND	-8.0	n/a	n/a
(52) 2,2',5,5'-Tetrachlorobiphenyl	ND	7.9	89.9	49	80.4	58.0
(66) 2,3',4,4'-Tetrachlorobiphenyl	53.6	16.6	ND	35	36.2	26.2
(101) 2,2',4,5,5'-Pentachlorobiphenyl	57.8	57.4	-3.5	37	40	35
(118) 2,3',4,4',5-Pentachlorobiphenyl	ND	2.7	2.3	2.5	0.3	0.2
(153) 2,2',4,4',5,5'-Hexachlorobiphenyl	ND	ND	9.5	9.5	n/a	n/a
(180) 2,2',3,4,4',5,5'-Heptachlorobiphenyl	ND	-9.6	ND	-9.6	n/a	n/a
(206) 2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl	-2.8	247.0	-17.0	75.7	168.0	148.5
(209) 2,2',3,3',4,4',5,5',6,6'-Decachlorobiphenyl	-18.5	ND	ND	-18.5	n/a	n/a

Table 5. Pesticide Blank Test Results Summary.

Pesticide	Blank Flux ($ng/m^2/day$)			Repeatability ($ng/m^2/day$)		
	Test 1	Test 2	Test 3	Average Flux	+/- 95% C.L.	Std. Deviation
alpha-Chlordane	7.0	ND	ND	7.0	n/a	n/a
2,4'-DDD	7.0	ND	ND	7.0	n/a	n/a
Methoxychlor	25.7	ND	ND	25.7	n/a	n/a
Endosulfan I	48.8	ND	ND	48.8	n/a	n/a
hexachlorobutadiene	ND	ND	22.0	22.0	n/a	n/a
Heptachlor	304.5	ND	ND	304.5	n/a	n/a
Heptachlor Epoxide	ND	ND	8.8	8.8	n/a	n/a
alpha-hexachlorocyclohexane	3.3	ND	ND	3.3	n/a	n/a
beta-hexachlorocyclohexane	61.0	ND	ND	61.0	n/a	n/a
lindane	35.2	132.3	33.8	67.1	63.9	56.5
trans-Nonachlor	40.8	ND	ND	40.8	n/a	n/a

5.1.2.1 Results of Organics Blank Tests

The Paleta Creek seawater collected for these tests contained a broad mixture of dissolved organic contaminants targeted by this study, but not all 63 of them. Of the 34 targeted organic contaminants that were detected, a number of them were not measurable in all three blank tests. Further, within a number of individual blank tests where a target contaminant was detected, one or more time-series samples fell below the detection limits. Notwithstanding such issues, analysis results plotted as time-series, with non-detects removed, show little if any, release or uptake of detected target contaminants by the BFSD2 with the exception of Naphthalene and Flouranthene. These two PAHs both consistently indicated an uptake trend likely due to sorption onto the many plastic surfaces of the collection chamber and recirculation system. Statistical analysis of the data for repeatability was applied to those tests with multiple measurements.

For the targeted EPA 16 Priority PAHs, the results were generally complete for the eight lowest molecular weight (through three Benzene rings) compounds. "Non detects" were much more prevalent with the eight heavier molecular weight PAHs (four-ring including Benzo(a)anthracene and higher) and four of the 16 targeted PAHs were not detected in all three blank tests although source seawater did indicate very low concentrations (less than 2 ng/L or parts/trillion) were present. Acenaphthene, a two-ring PAH, was the only low molecular weight compound not sufficiently detected in all three blank tests to establish repeatability statistics however a time-series flux trend (uptake or release) was established. Acenaphthene was detected in all three seawater source samples and in all 12 blank test 1 samples but dropped below detection limits in 10 of 12 blank test 2 samples and 9 of 12 blank test 3 samples. All remaining light-end PAHs (up to Pyrene) were detected in all 12 samples of all three blank tests and Table 3 provides full repeatability statistics for them. Time-series flux trends were also established for all of them. None of the heavier-end PAHs were detected sufficiently in all 12 samples of all three blank tests to yield full repeatability statistical results. Only Chrysene was detected sufficiently in two of the three blank tests to establish limited repeatability statistics. Benzo(b)fluoranthene, Benzo(k)fluoranthene and Benzo(g,h,I)perylene were detected sufficiently in only one blank test and repeatability statistics cannot be developed for them. Time-series flux trends were established for all four of these heavier-end PAHs. The remaining four PAHs (Benzo(a)anthracene, Benzo(a)pyrene, Indeno(1,2,3c,d)pyrene and Dibenz(a,h)anthracene) were not sufficiently detected in any of three blank tests to establish either repeatability statistics or time-series trends.

For the 20 targeted PCB congeners and 16 targeted pesticides, the results were somewhat less complete. Three PCB congeners (#18, #101, #206) and one pesticide (Lindane) were sufficiently detected in all three blank tests to establish full repeatability statistics and time-series flux trends. Two of the 20 PCBs and one of the 16 pesticides were detected sufficiently in two of the three blank tests to establish limited repeatability statistics and time-series flux trends. Four of 20 targeted PCBs and nine of the 16 targeted pesticides were detected in only one blank test with sufficient data to establish time-series flux trends, but not repeatability statistics. The remaining eleven PCB congeners and five pesticides were not detected sufficiently in any of the three blank tests to establish either repeatability statistics or time-series trends. Six of these remaining eleven PCB congeners and all five of these remaining pesticides were not detected in the unfiltered source seawater.

5.1.2.2 Discussion of Organics Blank Tests

It was not unexpected to find very low levels of the heavier PAHs dissolved in the source seawater because of the known reduction in solubility of PAHs as the number of Benzene rings increase. This insolubility, combined with a low, but limited detection limit led to less complete and even non-detection of the heavier PAHs. However, the number of Benzene rings common within groupings of

PAHs allows a limited extension of the otherwise generally complete results. This applies for groupings of two and three-ring contaminants as well as the less complete and even missing results within the four, five and six-ring contaminant groupings. Within groups, time-series results for missing PAHs can be predicted to be consistent with those that were measured. This prediction can be made for both the complete lighter PAH results and the less complete heavier PAH results. Overall, the results establish that the various plastic and other materials of the BFSD2 which are in contact with the sampled seawater do not adversely adsorb or release the target PAHs within measurable limits, with the possible exceptions of Naphthalene and Flouranthene, as described in the Results section. Apparent adsorption of these two PAHs introduces a relatively small error to field measurements which are subsequently resolved by normalization during data processing. Furthermore, careful consideration was made when materials for the chamber, mixing mechanism and sample bottles were considered. Surfaces for minimal adsorption or release of the entire suite of contaminants analyzed were considered and practical decisions made. With polycarbonate chamber, Teflon flow lines and valves and glass sample bottles, the BFSDII has the most practical combination of materials for the minimal adsorption of release of these contaminants. Finally, although repeatability statistics requires more than a single data set, and three tests were conducted, those contaminants with only two data sets were analyzed albeit with lower confidence results. The repeatability of PAHs with a single data set can only be estimated, with no statistical confidence, and the four heavier PAHs with no data sets can only be predicted, as above. Thus, because of the common attributes of groups of PAHs and with the established results where data were available, it is estimated and predicted that field measurements of those PAHs with incomplete blank test results will be approximately similar to the other more complete PAHs measured. At sites where precise measurements are required for targeted PAHs which were not established with this series of blank tests an additional blank test using site-specific seawater or clean seawter or clean seawter spiked with the target PAH(s) may be necessary

Common features among PCB congeners allow much the same degree of extension of results discussed above for PAHs. Pesticides do not however support the same degree of extension because of the uncertainty of their composition and the limited results achieved. Pesticides were detected at much lower concentrations than the PAHs. For both PCBs and pesticides, blank test data sets that were sufficiently complete did establish acceptable repeatability considering such low levels (<1 ng/L). The remaining blank tests (with only one data set) established, as with PAHs, that the various plastic and other materials of the BFSD2 which are in contact with the sampled seawater do not adsorb or release the particular PCB congener or pesticide within measurable limits. The time-series flux trends for these contaminants show low and variable rates (slopes). It is noted that PCB congener 18 (2,2',5-Trichlorobiphenyl) showed a small release during the first blank test, but did not repeat in subsequent tests. In order to make the most from the available data, especially where only one of the three blank tests had sufficient detects (i.e., at least 6 measurements distributed evenly or grouped at one end), non-detects were removed and the remaining measurements used. This approach was used extensively for the PCB congeners and pesticides and much less for the heavier PAHs (only).

Ancillary data collected and recorded, including chamber temperature, pressure, salinity, pH and dissolved oxygen indicated chamber conditions remained stable throughout the tests. The pH sensor recorded a slight reduction in pH (<0.5) which occurred gradually over 70 hours in all three tests. The pressure sensor recorded changes in barometric conditions as well as the vacuum affect of each sample collection bottle being activated at 7-hour intervals during the tests.
Silica measurements used to confirm chamber integrity during BFSD2 metals applications will not be used for organics applications. The need to conserve sample volume to maximize detection levels

combined with experience in comparing onboard sensors with silica results in previous tests supports reliance on the sensors to identify any loss of chamber seal integrity. Dissolved oxygen an pH followed distinct trends when the silica test indicated a good seal. These two parameters show promise in interpreting seal integrity and will be used during organics applications.

5.1.2.3 Organics Blank Tests Assessment

It was concluded that the BFSD2 organics blank performance was adequately established and the values obtained are sufficiently repeatable, precise and accurate to statistically distinguish differences from measured *in situ* sediment flux rates for a number of targeted PAHs. Measurement of *in situ* flux rates for selected PCB congeners and pesticides are also statistically distinguishable where blank test results are available.

5.1.3 San Diego Bay, Paleta Creek Metals Demonstrations

Two 70-hour metals demonstrations of BFSD 2 were conducted at the heavily industrialized Paleta Creek entrance to San Diego Bay (see Figure 33). The quiescent, marina-like area is used for mooring support craft and receives periodic stormwater inflow from the Paleta Creek drainage basin. The site was selected due to known levels of trace metals in the sediments, as established in two previous prototype BFSD tests, and because of its convenient location for an initial field test and first demonstration of BFSD2. Two demonstrations were conducted two weeks apart (June 6-8, 1998 and June 18-22, 1998) with the first demonstration being a full dress rehearsal for the second, formal demonstration. The locations for the tests were within 10 feet of one another and within the same proximity to two previous prototype BFSD deployments. The tests were conducted at about 18 +/- 3 feet depth, depending on tidal flow, and offshore about 30 feet from a quay wall. Deployment and retrieval was from the SSC SD research vessel R/V ECOS.

Figure 33. BFSD2 Paleta Creek Metals Deployment.

Prior to both tests, the BFSD 2 was cleaned and prepared using the same procedures used during the triplicate blank tests. Aboard R/V ECOS after loading and connecting various equipment (laptop computer, TV monitor and light, cabling) a standard pre-deployment checklist was followed. Once moored at the site with the GPS location logged, the BFSD 2 was lowered to within 2 feet of the bottom and a 15-minute test was started to stabilize the flow-through sensors and to measure the ambient dissolved oxygen level. This test was run twice during the first demonstration to assure repeatability. The ambient dissolved oxygen level is used to establish system control limits for maintaining a narrow range of dissolved oxygen in the collection chamber during the 70-hour test and for assessment of sediment oxygen uptake rates. As requested by CA EPA certification

evaluators, a second, independent dissolved oxygen measurement was made outside the collection chamber during the second demonstration by attaching an additional instrument to the BFSD 2 frame next to the collection chamber.

After entering the control limits into the 70-hour test program software and downloading it, the BFSD2 was raised for manual activation of the number one sample bottle valve. A new, higher mounting location for the valve was implemented following the blank tests to improve collection of representative ambient bottom water. With the BFSD2 partially submerged and the collection chamber approximately 3 feet below the surface, the valve was opened manually and the BFSD2 was immediately lowered back to approximately 2 feet from the bottom. After a short delay to arrange deck release lines, the BFSD2 was then allowed to free-fall to the bottom and insert its collection chamber into the sediment.

The landing and insertion were monitored using a video camera. Activation of the three insertion indicator lights was verified. The video camera, aided by a floodlight, also allowed a limited assessment of the site prior to initiating the 70-hour test. And, after starting the test, it also allowed confirmation of lid closure prior to complete detachment of lanyards and connections for autonomous operation. Both demonstration deployments were straightforward and without problems. The R/V ECOS returned to SSC SD and left the BFSD2 in its autonomous operation mode.

Retrieval of the BFSD2 after the tests was routine except for malfunction of the commercial acoustic recovery system. Recovery was with a separate line stowed at the site. Acoustic receiver burn-wire modification, latch modification, and most importantly, sandpaper cleaning of the ground electrode were subsequently implemented. Once BFSD2 was washed down and on deck, the twelve 250ml sample bottles were removed for processing using EPA handling and chain of custody procedures. During the first demonstration the samples were returned to SSC SD for splits (silica and metals). For the second demonstration splits were made aboard R/V ECOS using pre-acidified 125ml containers for metals samples and pre-cleaned 25ml beakers for silica measurements. Silica measurements were made aboard R/V ECOS using a field portable Hach model DR2010 Instrument. The metals samples were packaged and shipped to Battelle Marine Sciences Laboratory for analysis of the six metals selected for CA EPA certification evaluation. All data and results for the two demonstrations are compiled in Microsoft Excel spreadsheets "BFSD2 PCPD.xls" and "BFSD2 PCD.xls", provided with the electronic submission of this report. Appendix C provides copies of the spreadsheet results and includes data and graphs for the BFSD2 flow-through sensors.

Tables 6 and 7 summarize the results of the two Paleta Creek metals demonstrations.

Table 6. BFSD 2 Metals Results from the Paleta Creek Pre-Demonstration (PCPD).

Metal	Flux ($\mu g/m^2/day$)	+/- 95% C.L. ($\mu g/m^2/day$)	Flux rate Confidence (%)	Triplicate Blank Flux ($\mu g/m^2/day$) Average	+/- 95% C.L.	Bulk Sediment ($\mu g/g$)	Overlying Water ($\mu g/L$)
Copper (Cu)	-1.75	19.71	38.1%	2.82	8.73	165	1.54
Cadmium (Cd)	9.64	4.14	100.0%	-0.52	0.75	1.16	0.148
Lead (Pb)	11.06	7.94	100.0%	3.16	1.59	98.9	0.1561
Nickel (Ni)	25.24	4.62	100.0%	10.28	7.34	19.1	0.9262
Manganese (Mn)	71.33	701.54	80.7%	-264.85	7.49	405	28.12
Manganese (Mn)[1]	5763.99	23621.74	100.0%	-264.85	7.49	405	28.12
Zinc (Zn)	715.02	257.38	100.0%	-3.38	65.22	356	8.90
Other							
Oxygen (O_2)* (*$ml/m^2/day$)	-1050.87	86.25	na	na	na	na	5.2
Silica (SiO_2)* (*$mg/m^2/day$)	30.29	11.33	100%	-1.97	2.88	na	0.81

1. Mn flux calculated on the basis of first three samples due to non-linearity

Table 7. BFSD 2 Metals Results from the Paleta Creek Demonstration (PCD).

Metal	Flux ($\mu g/m^2/day$)	+/- 95% C.L. ($\mu g/m^2/day$)	Flux rate Confidence (%)	Triplicate Blank Flux ($\mu g/m^2/day$) Average	+/- 95% C.L.	Bulk Sediment ($\mu g/g$)	Overlying Water ($\mu g/L$)
Copper (Cu)	-6.57	17.74	80.7%	2.82	8.73	165	1.46
Cadmium (Cd)	7.02	3.87	100.0%	-0.52	0.75	1.16	0.06897
Lead (Pb)	4.32	12.39	65.6%	3.16	1.59	98.9	0.07879
Nickel (Ni)	19.44	8.75	99.8%	10.28	7.34	19.1	0.8378
Manganese (Mn)	103.94	957.14	73.3%	-264.85	7.49	405	24.02
Manganese (Mn)[1]	4194.24	101841.32	99.9%	-264.85	7.49	405	24.02
Zinc (Zn)	574.26	274.14	100%	-3.38	-68.61	356	8.38
Other							
Oxygen (O_2)* (*$ml/m^2/day$)	-1341.12	160.18	na	na	na	na	4.7
Silica (SiO_2)* (*$mg/m^2/day$)	28.75	15.63	100%	-1.97	2.88	na	0.79

1. Mn flux calculated on the basis of first three samples due to non-linearity

Numbers in the Flux Rate Confidence column indicate the statistical confidence that the measured flux rate is different than the blank flux rate. Results from the blank study, bulk sediment analysis, overlying water and oxygen uptake analysis are shown for comparison.

Figures 34 and 35 illustrate graphical comparison of the results.

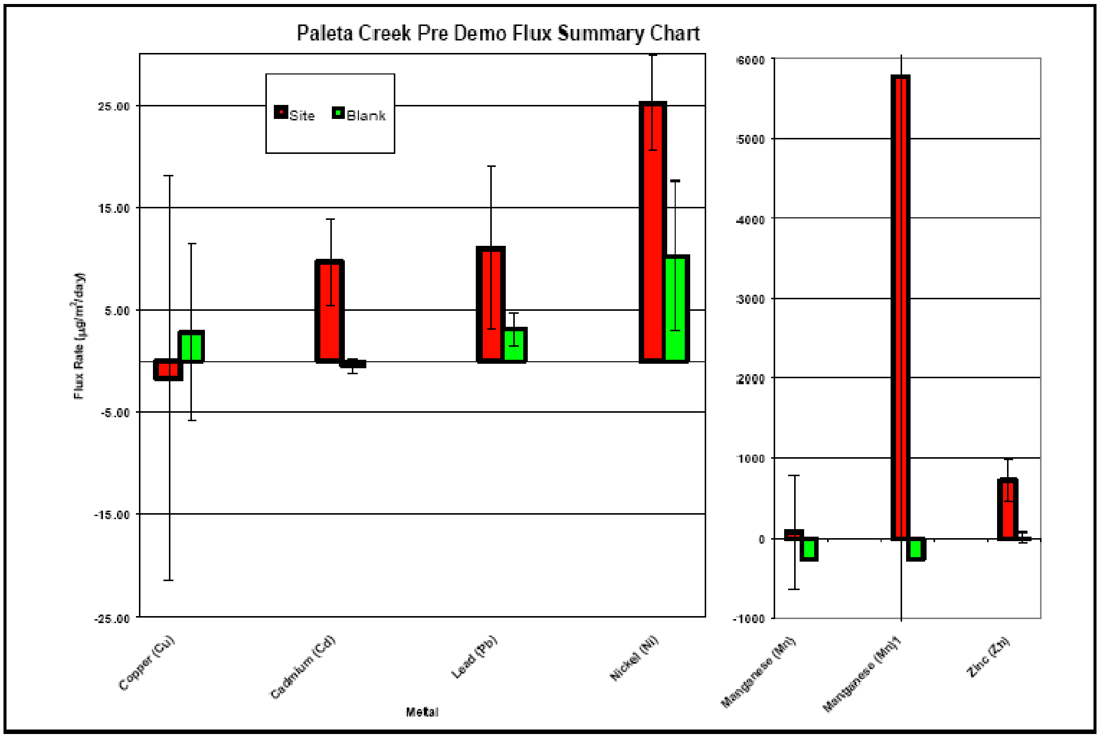


Figure 34. Paleta Creek Metals Pre-Demonstration Results.

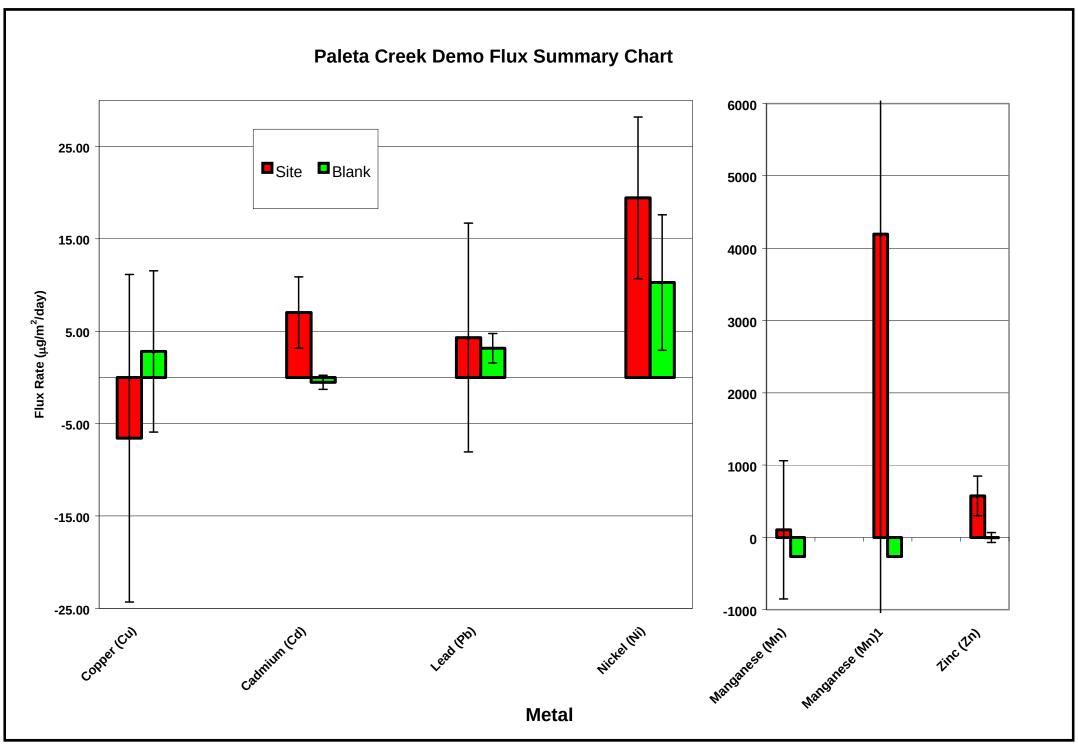


Figure 35. Paleta Creek Metals Demonstration Results.

5.1.3.1 Discussion of Paleta Creek Demonstrations Results

In general, BFSD2 results from the two Paleta Creek demonstrations were similar and consistent with previous prototype deployments at this location. Figures 36 and 37 are the sets of graphs of concentration versus time for each analyte (red squares) in each of the demonstrations, compared with blank performance (blue triangles). The concentrations of analyte plotted on these graphs here and throughout this report are not the measured concentrations of each sample but concentrations that have been corrected for dilution effects from sampling water from the chamber and intercept corrected for the linear slope analysis. Therefore the concentrations shown could change depending on how many samples are included in the slope analysis. This is illustrated well in the manganese graphs where two slope analyses were performed with different numbers of samples. It appears concentrations for each sample are different. These graphs were generated in the process of calculation the slope or flux of each analyte, and it is the flux rate and not individual sample concentrations which are interpreted in these graphs.

The results for the Pre-Demonstration indicate that Cadmium, Lead, Nickel and Zinc had fluxes out of the sediment that were highly significant when compared to the blank chamber results. The flux of copper indicated a negative flux (sediment uptake) although the statistical confidence was only 65%.

Manganese fluxes showed a consistent trend or pattern here at Paleta as well as at subsequent deployments in Pearl Harbor. Flux curves would define a higher rate of flux in the first part of the test while becoming lower or negative in the later part. The reason for this drop is not known, but could be attributed to oxidation and subsequent precipitation or flocculation when the chamber water reached a high concentration which results in a “quenching”-like trend. Certainly some process was changing the flux rate of manganese as the test proceeded. So, in order to estimate actual flux rates of manganese from sediments as if the chamber were not present, the first three values obtained from the test was used for calculating a flux rate. This is similar to how dissolved oxygen demand is calculated before the system becomes anoxic and/or the oxygen feed system kicks in. This approach results in a more conservative estimate of flux rates for this metal, i.e. higher outward fluxes. We will use and discuss the flux values obtained from this later method of using the first three samples drawn from the chamber for manganese. However, flux curves and values from estimated from the entire test duration are also presented here for consideration. Therefore, manganese also had a positive outward flux as did cadmium, lead, nickel and zinc but the statistical confidence was somewhat lower.

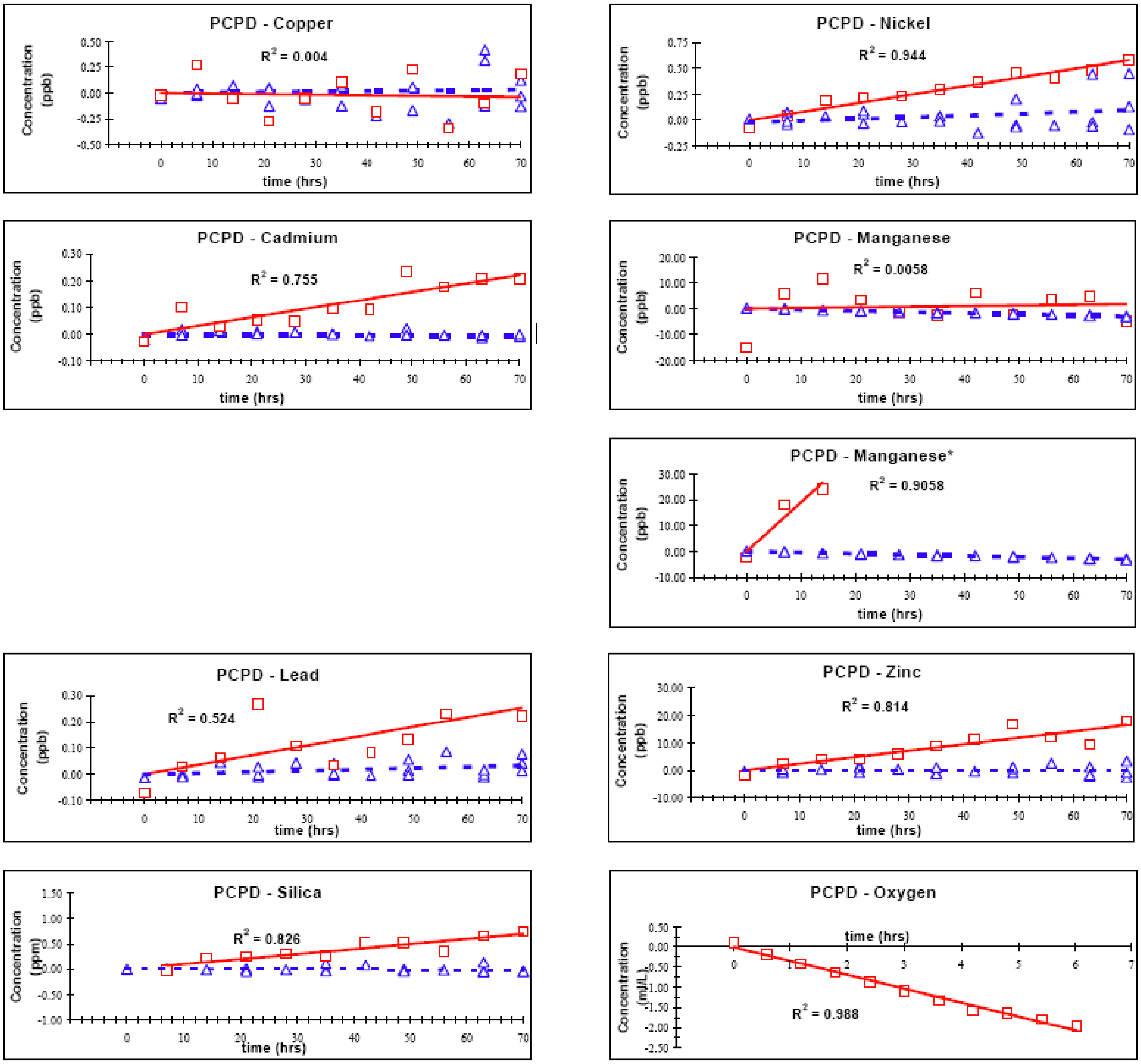


Figure 36. Paleta Creek Metals Pre-Demonstration Concentration vs. Time.

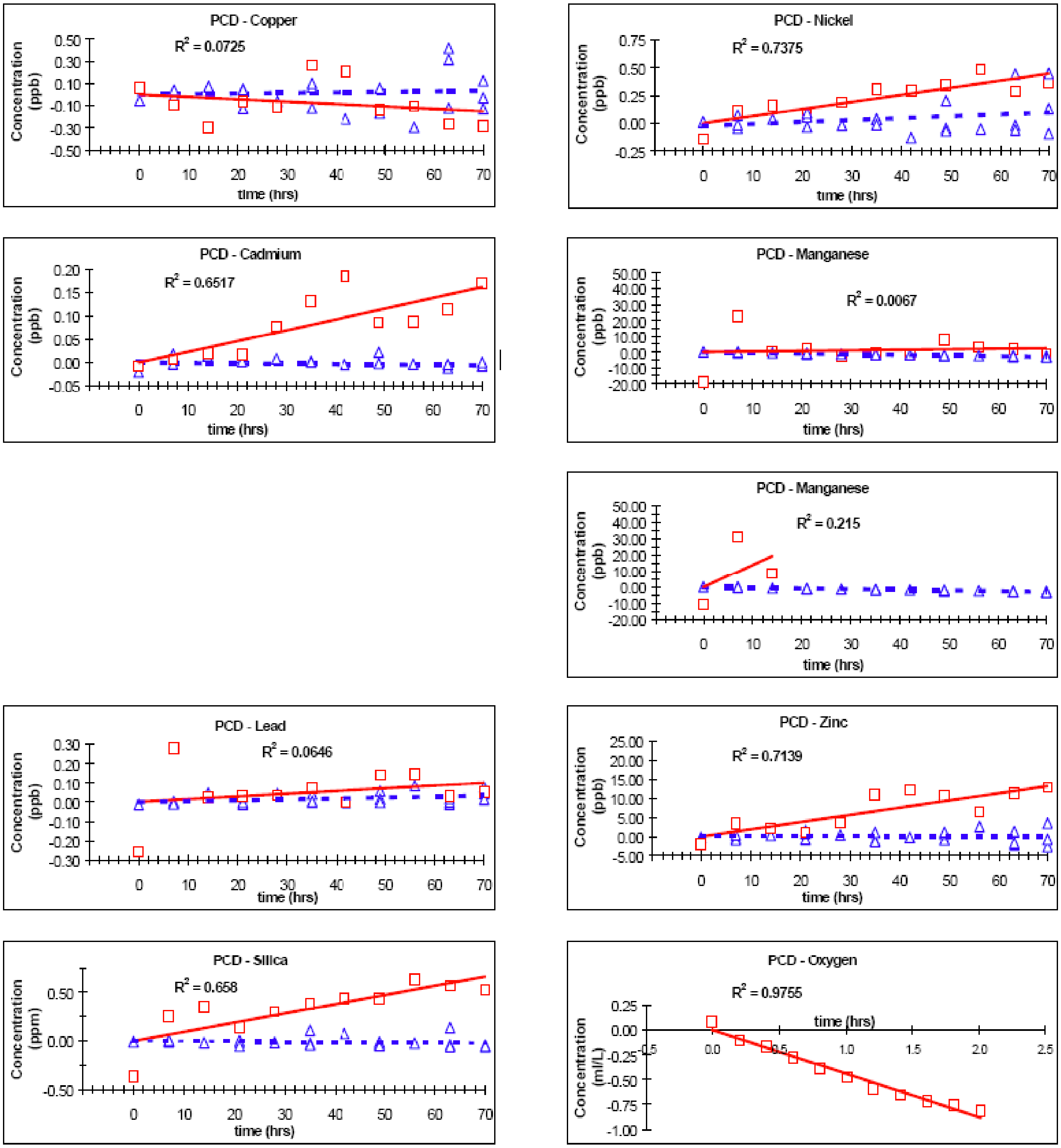


Figure 37. Paleta Creek Metals Demonstration Concentration vs. Time.

Results for the formal Demonstration were similar to those of the Pre-Demonstration with the exception of Lead. Cadmium, Nickel and Zinc all had fluxes out of the sediment that were highly significant when compared to the blank results. The magnitude of the Cadmium, Nickel and Zinc fluxes for the Demo were similar, though slightly lower, than those observed for the Pre-Demonstration. Manganese again had a positive outward flux but a lower statistical confidence. As with the Pre-Demonstration, the flux of copper was negative (sediment uptake) although the statistical confidence was <0.1%.

5.1.3.1.1 Flux Measurements

As shown in Tables 6 and 7, and illustrated in Figures 34 through 37, cadmium, lead, nickel, manganese and zinc all had positive flux rates which were statistically different from blank test results. Also, the relative magnitudes of the flux rates were consistent for both demonstrations and with earlier prototype work at the site. In other words, zinc had a larger flux rate than manganese; manganese was larger than nickel; nickel was larger than lead; lead and cadmium were very close to the same magnitude. The magnitude of the flux rates for the formal Demonstration were generally similar, though somewhat less (except manganese), than those of the Pre-Demonstration test two weeks earlier, however, the differences are not statistically significant. A correlation with sediment oxygen uptake is evident and may be an explanation for the slight downward shift of fluxes. The flux rate for manganese is likely more positive than measured when corrected by the large, very repeatable negative flux measured in the blank tests. Copper results indicate a slightly negative flux (sediment uptake) which has been observed in previous work. This may be attributed to pore water chemistry involving sulfide binding, complexation with organic matter, or elevated water column concentrations associated with hull leachate sources as discussed extensively in earlier reports. The oxygen uptake measured during both deployments is consistent and indicates continuous consumption of dissolved oxygen, which can be attributed to oxidation of organic matter and biological uptake at the sediment water interface.

5.1.3.2 Discussion of Paleta Creek Demonstrations Tests

Important aspects of the demonstrations including performance indicators and deployment problems are discussed below.

5.1.3.2.1 Performance Indicators

Several methods were used to evaluate system performance of the BFSD2 during and after the demonstrations. To assure a proper seal of the chamber, the deployment was monitored with an underwater video camera, insertion light indicators connected to pressure sensors on the sealing flange were monitored, and silica, pH, and oxygen levels within the chamber were monitored for expected trends. Landing and insertion monitored with the video camera and landing lights indicated a good seal. After starting the test, the video camera also confirmed lid closure of the chamber.

A linear increase in silica during the deployments was used as another indicator of proper system performance and chamber seal. The results, shown on Figures 36 and 37, show that silica concentration increased linearly, and that the silica flux rates were consistent and repeatable for the two deployments, indicating proper system performance and chamber seal. Oxygen variations in the chamber were monitored to assure maintenance of ambient oxygen levels, proper chamber seal, and to evaluate sediment oxygen uptake. The rate of oxygen consumption (sediment uptake) during the deployments, also shown in

Figures 36 and 37, was sufficient to cause repeated cycling of the BFSD2 oxygen recharge subsystem. Figure 38 are graphs of the oxygen sensor data for the two deployments showing the operation of the control system. The control limits selected allowed the dissolved oxygen to remain within approximately 1 ml/L of the ambient level and still yield data to assess the sediment uptake rate. The multiple cycles for both recharge and uptake were consistent and repeatable.

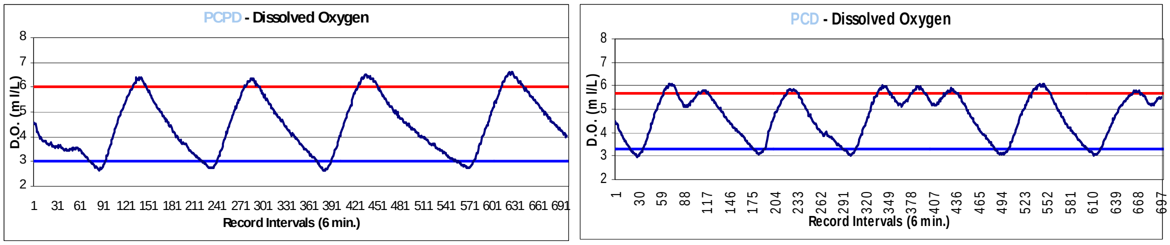


Figure 38. Paleta Creek Metals Demonstrations Oxygen Control Results.

As requested by CA EPA certification evaluators, an independent dissolved oxygen measurement of ambient bottom water at the BFSD2 test site was made during the formal Demonstration deployment. The measurement instrument was battery power-limited and operated for only the first 39 hours of the deployment. During that period, cyclic changes of approximately 0.5 ml/L occurred about the ambient level of approximately 5 ml/L. Thus oxygen results reconfirm that a proper chamber seal was achieved, and that oxygen levels within the chamber were maintained close to the ambient level and with similar, though slightly larger, variability to that observed outside the chamber.

In the properly sealed BFSD 2 chamber, the pH will generally show a decreasing trend as the breakdown of organic matter at the sediment water interface drives CO_2 into the chamber water. This decreasing trend was observed during both deployments as shown in Figure 39. Some small fluctuations from the expected steady decline in chamber pH were seen. While the exact cause of these fluctuations is not known, a number of factors including photosynthetic activity and sediment and pore water oxidation chemistry can account for the minor reversals. In the absence of other evidence of a breech in chamber seal, these small fluctuations were attributed to natural variations.

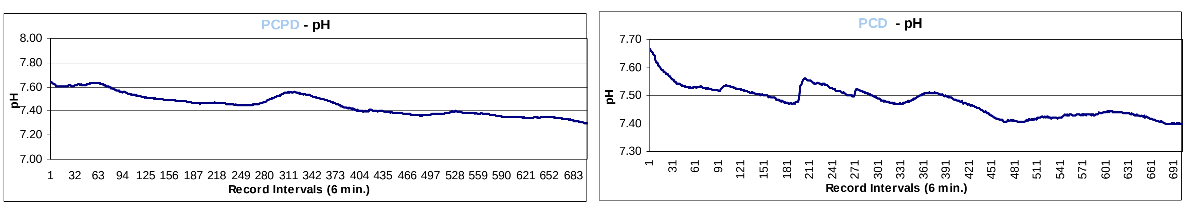


Figure 39. Paleta Creek Metals Demonstrations pH Results.

5.1.3.2.2 Deployment and Recovery Problems

Two minor problems were encountered during the demonstrations. The first was failure of the commercial acoustic recovery system to function. During the Pre Demonstration the failure was attributed to one too many burn-wire strands which led to excessive time for functioning. One strand was removed for the next test, however the release latch mechanism was corroded and failed to release the buoy after the burn-wire had properly functioned. The latch was subsequently modified and is an inspection point as part of the pre-deployment checklist procedure. Most importantly it was determined that abrasive cleaning of the ground (plating) electrode with sandpaper must be performed after every use.

The second problem was the concentration of metals in the water collected from the open chamber, as it descended to the bottom was not consistent with concentrations in the chamber shortly after it reached the bottom. The values from laboratory analysis of the water in sample bottle one (which filled during descent, after manual operation of its valve near the surface) and from water in sample bottle number two (filled from the chamber 6 minutes after lid closure) were inconsistent. As with the blank tests, the concentration values from the second sample bottle were considered more representative of makeup water entering the chamber and were used in dilution correction calculations. And, as with the blank tests, a sensitivity analysis indicated an insignificant affect on flux results. A more acceptable method for collecting representative bottom water was subsequently implemented and test deployed prior to the Pearl Harbor demonstrations.

5.1.3.3 Discussion of Data Interpretation

In order to understand the significance of the measured flux rates in Paleta Creek from a water quality standpoint, it is necessary to estimate the potential loading and subsequent increase in metals concentrations within the overlying water. A simplified analysis is presented here in order to illustrate the utility of the BFSD2 data for this purpose.

The Paleta Creek study area where the demonstrations were performed is bordered by land on three sides, and open to San Diego Bay only to the southwest. The bounded area has a surface area of about 62400 m^2. The average depth of the area is about 7 m, and thus the overall volume is about 436800 m^3. The tidal range in San Diego Bay averages about 1.4 m. A simple estimate of the residence time can be obtained based on complete tidal flushing as

$$\tau_{res} = \frac{V_{pc}}{V_{tp}} = \frac{D_{pc}}{H_t N_t} = \frac{7}{1.4 \times 2} = 2.5\ days$$

Where τ_{res} is the residence time, V_{pc} is the volume of the Paleta Creek study area, V_{tp} is the tidal prism volume for the area, D_{pc} is the depth of the study area, H_t is the tidal range, and N_t is the number of tides per day.

In steady state conditions, the residence time can be related to the overlying water concentration by the relation

$$\tau_{res} = \frac{m_{ow}}{\dot{m}_{sed}}$$

Where m_{ow} is the mass of a given metal in the Paleta Creek study area overlying water, and m_{sed} is the loading from the sediment.

The overlying water concentration can thus be estimated from the flux rates as

$$c_{ow} = \frac{m_{ow}}{V_{pc}} = \frac{\tau_{res}\dot{m}_{sed}}{V_{pc}} = \frac{\tau_{res}F_{sed}A_{pc}}{V_{pc}} = \frac{\tau_{res}F_{sed}}{D_{pc}}$$

Where F_{sed} is the sediment flux rate measured by the BFSD, and A_{pc} is the surface area of the sediment in the Paleta Creek study area. Using this relation, the estimated overlying water concentrations for each of the metals from each of the surveys can be estimated as shown in Table 8 below.

Table 8. Estimated Sediment Flux Contribution to Overlying Water Concentrations for the Paleta Creek Study Area.

Metal	PCPD Flux	PCD Flux	τ_{res}	D_{pc}	C_{ow} PCPD	C_{ow} PCD	C_{ow} meas.	PCPD % of meas.	PCD % of meas.
	μg/m²/day	μg/m²/day	days	m	ug/l	ug/l	ug/l		
Copper (Cu)	-2	-7	2.5	7	-	-	2.41	-	-
Cadmium (Cd)	10	7	2.5	7	0.0036	0.0025	0.0786	4.54%	3.2%
Lead (Pb)	11	4	2.5	7	0.0039	0.0014	0.182	2.16%	0.8%
Nickel (Ni)	25	19	2.5	7	0.0089	0.0068	1.02	0.88%	0.7%
Manganese (Mn)	73	105	2.5	7	0.0261	0.0375	21.0	0.12%	0.2%
Zinc (Zn)	716	575	2.5	7	0.2557	0.2054	8.91	2.87%	2.3%
Silica (SiO_2)	30*	30	2.5	7	0.011 **	0.011 **	0.79 **	1.35%	1.4%

*mg/m²/day **mg/l

Note: C_{ow} measured is the overlying water concentration that was measured during the PCD study. The percent of measured column indicates the fraction of the overlying water concentration that can be explained by the sediment flux.

Comparing the estimated overlying water concentration to the measured concentration indicates that the contribution due to sediment fluxes ranges from a high of 4.5% for cadmium, to a low of about 0.2% for manganese. In practice, these estimates could be used to evaluate the potential benefit of a sediment removal or capping action compared to a no-action scenario. The simple model employed here neglects many factors such a s tidal flushing efficiency of the study area and scavenging of metals near the sediment-water interface that could influence the estimated concentrations. If the tidal flushing is not complete (which is realistic), then the residence time and estimated contribution from the sediments would increase. A typical flushing efficiency is about 50%, which wou ld increase the estimated Cow by a factor of 2. Colloid and particle scavenging near the sediment water interface would tend to reduce the s ediment flux contribution, although the magnitude of this process is not well known.

5.1.4 San Diego Bay, Paleta Creek Organics Demonstration

One 70-hour organics test using Benthic Flux Sampling Device 2 (BFSD2) was conducted March 2-5, 2001 at the heavily industrialized Paleta Creek entrance to San Diego Bay, within the borders Naval Station San Diego. Figure 40 is a picture o f the area which is used for mooring Navy industrial waste and sewage collection barges, emergency oil spill response vessels, and other transient industrial support vessels. The site was selected as one heavily studied over the years and likely to produce detectable and mobile organic contaminants. Also, the site was used for the BFSD2 *metals* flux demonstrations during June, 1998 and has subsequently been designated by the California Regional Water Quality Control Board as San Diego Bay's most "toxic hotspot". A sediment survey of the area conducted by SSC SD during December, 2000 using gravity core samples produced high levels of the US EPA's 16 priority Polynuclear Aromatic Hydrocarbons (PAH) expressed as Total Petroleum Hydrocarbons (TPH). The site was also a convenient location for this first organics field test. The tests were conducted at about 18 +/- 3 feet depth, depending on tidal flow, and offshore from a quay wall about 30 feet. Deployment and retrieval was from the SSC SD research vessel (R/V) Ecos.

Figure 40. Paleta Creek, San Diego Bay.

Prior to the test, the BFSD2 was cleaned and prepared using the same procedures used for the triplicate organics blank tests. Aboard R/V Ecos, after loading and connecting various equipment (laptop computer, TV monitor and light, cabling) a standard pre-deployment checklist was followed. Once moored at the site with the GPS location logged, the BFSD2 (shown in Figure 41) was lowered to near the bottom and the landing

Figure 41. BFSD2 Paleta Creek Organics Deployment.

site was surveyed by remote video for any obstructions or other features which could prevent successful insertion of the collection chamber into the sediment. The BFSD2 was then lowered to the bottom at the maximum rate allowed by the deck hoist (about 1ft/sec) and the landing and insertion were monitored using the video camera. Activation of three battery-powered lights by switches mounted on the chamber at the 3-inch level was verified and used to establish adequate sediment insertion. The landing produced a minimal amount of resuspension. The 15-minute "Sensor Check" program was then started to close the chamber lid, to stabilize the flow-through sensors and to measure the ambient dissolved oxygen level. Closing the chamber lid sealed the chamber and activated collection of an ambient water sample. Measurement of the ambient dissolved oxygen level was used to establish system control limits for maintaining a narrow range of dissolved oxygen in the collection chamber during the 70-hour test. Dissolved oxygen measurements data taken during the test are also used for assessment of sediment oxygen uptake rates.

After establishing and entering the dissolved oxygen control limits into the 70-hour test program and downloading it to the BFSD2, the flux test was started. The initial autonomous functions were monitored from R/V Ecos to assure proper operation of the BFSD2 prior to disconnecting the cables and dropping them overboard. Proper data recording and rotary sample valve commands were confirmed. R/V Ecos departed the site and left BFSD2 in place to perform the 70-hour autonomous sampling operation.

Retrieval of BFSD2 after completion of the test, shown in Figure 42, was routine except for malfunction of the commercial acoustic recovery system (the latch required subsequent modification). Recovery was aided by the clarity of the water and allowed a boat hook to be used to jar the recovery buoy loose from the BFSD2. Once BFSD2 was washed down and on deck, the twelve 250 ml sample bottles were removed for processing using EPA handling and chain of custody procedures. All bottles were full and inline filter elements were slightly discolored, indicating low turbidity within the chamber. Before moving location, a sediment sample was collected from the BFSD2 landing site. Onboard R/V Ecos, the sample bottle filter assemblies were removed and replaced with precleaned caps, preprinted labels were attached to the samples and packaging for overnight shipment was completed.

Figure 42. BFSD 2 Paleta Creek Organics Demonstration Recovery.

As the samples were being processed onboard R/V Ecos, the recorded data files from the 70-hour test were uploaded and entered into a standardized Excel spreadsheet template for data processing. The sensor data, plotted as time-series indicated a successful deployment. As can be seen in Figure 43, there was no sudden pH level shifts indicating loss of chamber seal and the oxygen control system maintained the dissolved oxygen level within the set limits. The slowly reducing trend for pH level was normal and is indicative of biological activity. The slight increases observed in pH near 28 hours and again near 50 hours correspond to midday periods and are most likely associated with benthic algal production and a corresponding consumption of $C0_2$ and increase in pH. Salinity, temperature and pressure were also normal.

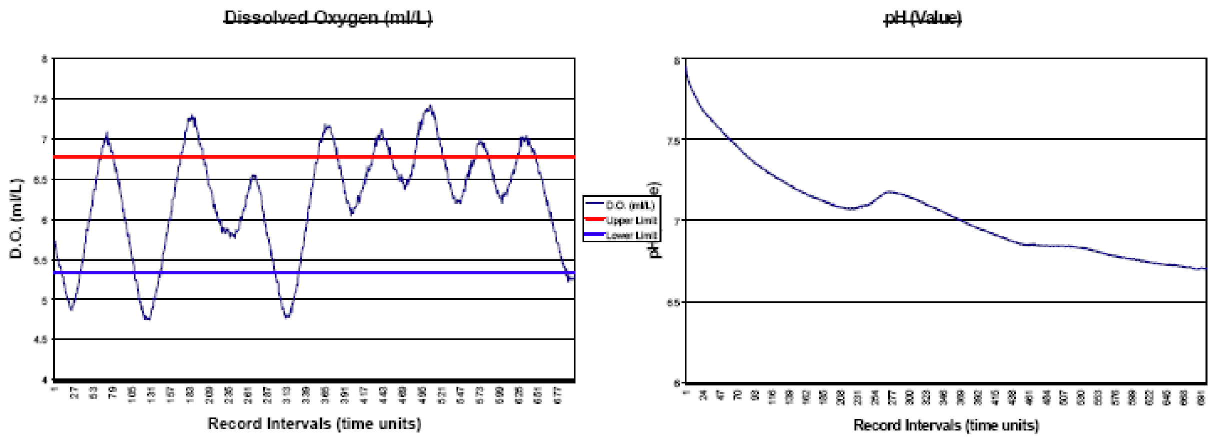


Figure 43. BFSD 2 Paleta Creek Organics Demonstration Recovery.

The samples were packaged and overnight air-shipped that afternoon to ADL for extraction and analysis in accordance with the processes, procedures and controls established under the Method Detection Limit study and used for the triplicate blank tests. All data and results for the demonstration are compiled in Microsoft Excel spreadsheets “PC Organics Demo - PAHs (Part1&2).xls”, “PC Organics DemoPCBs.xls” and “PC Organics Demo-Pesticides.xls” provided with the electronic submission of this report. Appendix C provides copies of the spreadsheet results and includes data and graphs for the BFSD2 flow-through sensors.

Tables 9, 10 and 11 provide a summary of the flux results for selected PAHs, PCB congeners and pesticides for the Paleta Creek organics demonstration.

Table 9. BFSD2 PAH Results Summary for Paleta Creek Demonstration.

PAH	Flux	+/- 95% C.L.	Flux Rate Confidence	Triplicate Blank Flux ($ng/m^2/day$)		Bulk Sediment	Overlying Water
	($ng/m^2/day$)*	($ng/m^2/day$)	(%)	Average	+/- 95% C.L.	(ng/g)	(ng/L)
1. Naphthalene	459.20	429.58	94.5%	-440.30	458.38	13	6.7
2. Acenaphthene	337.58	178.97	100.0%	-32.40	50.34	19	9.7
3. Acenaphthylene	105.51	183.82	33.8%	208.47	112.60	220	7.6
4. Fluorene	173.17	149.76	100.0%	-76.74	28.38	34	2.3
5. Phenanthrene	489.25	659.77	100.0%	10.95	10.95	240	8.2
6. Anthracene	569.42	260.29	100.0%	117.68	64.62	470	5.3
7. Fluoranthene	365.55	397.63	100.0%	-1423.95	178.41	890	37
8. Pyrene	951.97	755.67	100.0%	-439.51	70.73	740	13
14. Indeno(1,2,3-c,d)pyrene	-65.35	906.77	NA	NA	NA	470	1.4
16. Benzo(g,h,i)perylene	-46.63	263.97	67.7%	20.15	65.15	400	1.4

Table 10. BFSD2 PCB Results Summary for Paleta Creek Demonstration.

PCB	Flux	+/- 95% C.L.	Flux rate Confidence	Blank Flux ($ng/m^2/day$)		Bulk Sediment	Overlying Water
	($ng/m^2/day$)*	($ng/m^2/day$)	(%)	Flux	+/- 95% C.L.	(ng/g)	(ng/L)
18 - 2,2',5-Trichlorobiphenyl	52.21	103.93	4%	76.82	36.49	2.6	ND
28 - 2,4,4'-Trichlorobiphenyl	41.52	80.03	61%	-8.05	82.03	2.2	1.1
52 - 2,2',5,5'-Tetrachlorobiphenyl	9.44	105.28	77%	72.74	28.12	4.9	3
66 - 2,3',4,4'-Tetrachlorobiphenyl	-19.94	62.01	96%	37.74	25.45	5.3	ND
101 - 2,2',4,5,5'-Pentachlorobiphenyl	45.99	84.57	17%	57.59	31.49	13	ND
118 - 2,3',4,4',5-Pentachlorobiphenyl	-2.34	123.95	9%	2.51	15.40	13	ND
153 - 2,2',4,4',5,5'-Hexachlorobiphenyl	22.26	78.55	43%	9.45	11.71	23	0.11

Table 11. BFSD2 Pesticide Results Summary for Paleta Creek Demonstration.

Pesticide	Flux	+/- 95% C.L.	Blank Flux ($ng/m^2/day$)		Bulk Sediment	Overlying Water
	($ng/m^2/day$)*	($ng/m^2/day$)	Flux	+/- 95% C.L.	(ng/g)	(ng/L)
2,4'-DDT	57.49	95.75	NA	NA	3.6	0.88
4,4'-DDT	31.23	55.47	NA	NA	14	ND
Dieldrin	-23.48	45.68	NA	NA	2	ND
Hexachlorobenzene	23.76	35.20	NA	NA	0.61	ND
Mirex	36.23	154.93	NA	NA	ND	ND

Numbers in the Flux Rate Confidence column indicate the statistical confidence that the measured flux rate is different than the blank flux rate. Results from the blank study, bulk sediment analysis and overlying water are shown for comparison.

Figures 44, 45 and 46 provide graphical comparison of the flux results with the blank tests results.

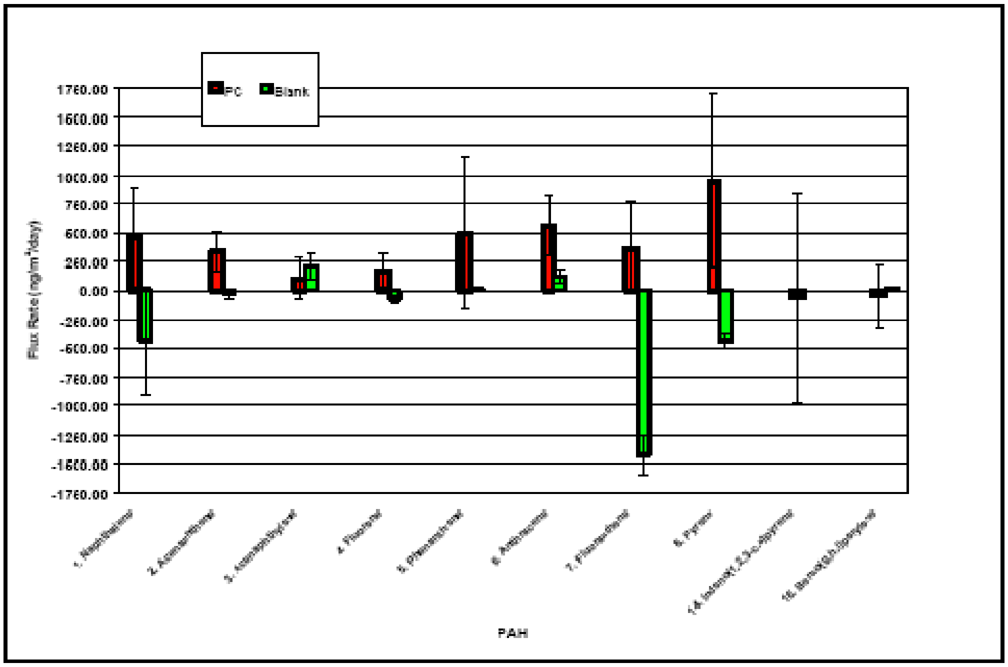


Figure 44. Paleta Creek PAH Demonstration Results.

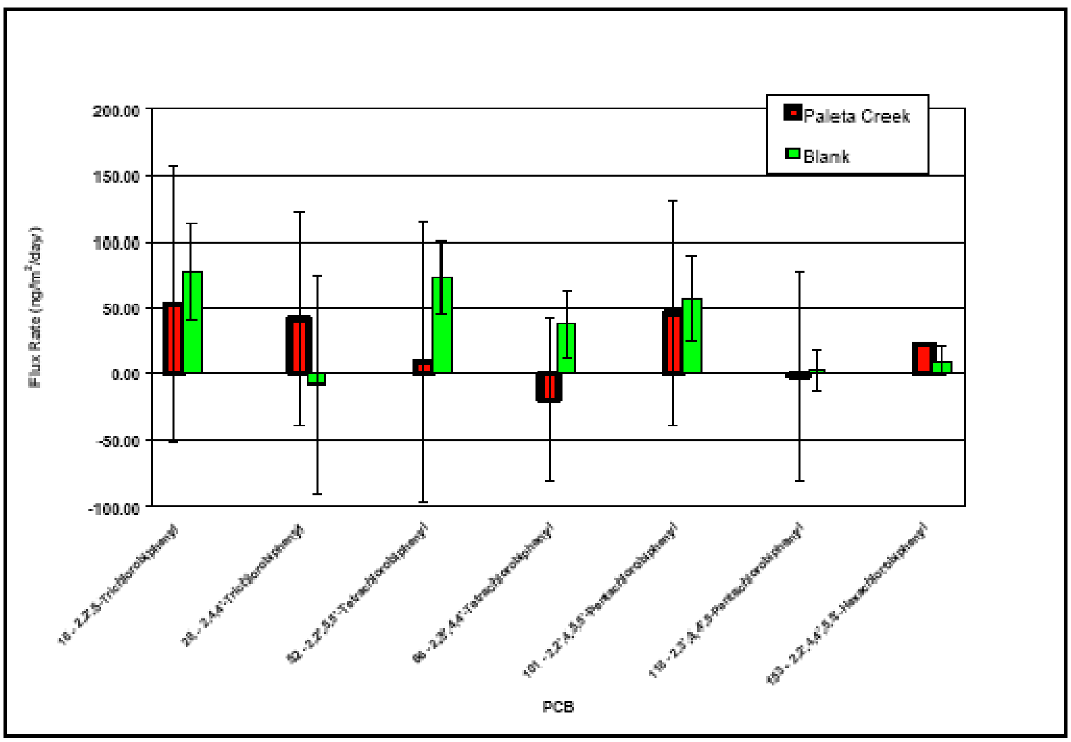


Figure 45. Paleta Creek PCB Demonstration Results.

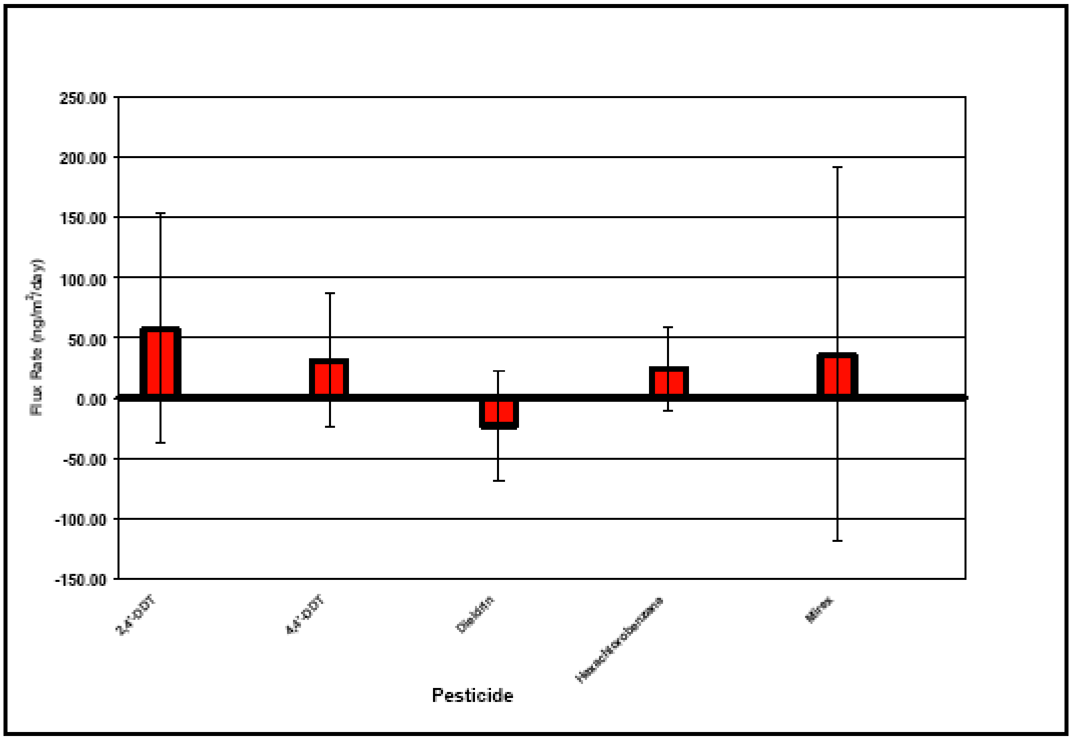


Figure 46. Paleta Creek Pesticide Demonstration Results.

5.1.4.1 Paleta Creek Organics Demonstrations Results

5.1.4.1.1 Polynuclear Aromatic Hydrocarbons (PAHs) Results

Complete individual data sets were obtained for six of the first eight PAHs (Naphthalene, Acenaphthene, Acenaphthylene, Phenanthrene, Fluoranthene and Pyrene). For the two incomplete data sets, non-detects were reported in two samples for Fluorene (samples 4 and 6) and in one sample for Anthracene (sample 2). The non-detects were removed from the data series for flux computations. All trends in concentration change were positive over time (i.e. sediment *release*) and the largest change among the first eight PAHs during the 70-hour test, after correction for dilution, was 18.9 ng/L (parts per trillion) for Phenanthrene. Most of the other PAHs changed less than 10 ng/L. The resulting concentration trends, when compared to the statistically derived triplicate blank test trends showed significant flux for seven of the eight lightest molecular weight PAHs. The confidence that the flux was statistically different than the associated blank was 100% for six of the first eight PAHs and 94.5% for Naphthalene. Acenaphthylene was the only PAH in the first eight with a flux less than the associated blank tests and it had a resultant flux rate confidence of 33.8%. Appendix D ("PC Organics Demo-PAHs (Part 1).xls") includes time-series graphs showing flux and blank tests concentrations over time for the eight lightest molecular weight PAHs. These graphs show reasonable linearity of the time-series flux test data and allow intuitive comparison of the flux and blank test results.

Of the remaining eight targeted PAHs with the heaviest molecular weights all but two were non-detectable throughout the full set of 12 samples. For the two with detects, Indeno(1,2,3-c,d)pyrene yielded four (samples 1,3,5,and 12) and Benzo(g,h,i)perylene yielded five (samples 1,3,5,8,and12) detectable concentrations. Additionally, only Benzo(g,h,i)perylene had adequate blank test results during the earlier triplicate test series for comparison. The Benzo(g,h,i)perylene flux, adjusted for

dilution, was negative (i.e. sediment *uptake*) and in comparison to its blank results there was a 67.7% confidence that the flux is different than the blank results. Indeno(1,2,3-c,d)pyrene also indicated a negative flux and there is no blank results for comparison. The time-series graphs included in Appendix D ("PC Organics Demo-PAHs (Part 2).xls") show the slight negative slopes, or concentration changes over time, for these two heavier molecular weight PAHs.

5.1.4.1.2 Polychlorinated Biphenyl (PCB) Congeners Results

Seven PCB congeners yielded sufficiently complete data sets for flux computations. PCB #28 (2,4,4'-Trichlorobiphenyl) yielded a complete set of 12 detectable concentration values. PCBs # 18 (2,2',5-Trichlorobipheny) yielded 9 samples with detectable concentration levels, #52 (2,2',5,5'-Tetrachlorobiphenyl) yielded 11 samples with detectable concentration levels, #66 (2,3',4,4'-Tetrachlorobiphenyl) yielded 10 samples with detectable concentration levels, #101 (2,2',4,5,5'-Pentachlorobiphenyl) yielded 8 samples with detectable concentration levels, #118 (2,3',4,4',5-Pentachlorobiphenyl) yielded 8 samples with detectable concentration levels, and #153 (2,2',4,4',5,5'-Hexachlorobiphenyl) yielded 11 samples with detectable concentration levels. In most cases, the partial data sets were composed of consecutive sample detects following initial non-detects in the series. As with PAHs, the non-detects were removed from the data series for flux computations. Five of the seven PCBs exhibited a positive trend in concentration over time (i.e. sediment *release*) and two exhibited a negative trend (i.e. sediment *uptake*). Three of the five PCBs indicating sediment release exhibited flux levels higher than the associated blank test levels and two were lower. The two PCBs indicating negative flux (sediment *uptake*) had positive blank test flux values. All changes in PCB concentration over the 70-hour test were less than 2 ng/L (parts per trillion) with the largest change (approximately 1.5 ng/L) exhibited by PCB #52. Statistical flux confidence is not high for six of the computed flux values when compared to associated blank test results. Statistical flux confidence for PCB#66 (2,3',4,4'-Tetrachlorobiphenyl) was 96%, however negative, or *uptake*, value introduces concern of validity and may be the result of the low concentrations measured. Appendix D ("PC Organics Demo-PCBs.xls") includes time-series graphs showing flux and blank tests concentrations over time for the seven PCBs with detectable concentrations. These graphs show marginal linearity of the time-series flux and blank test data resulting from the very low concentrations measured. Intuitive comparison of the flux and blank test results is illustrative of the low computed flux confidence levels reported in Table 10.

5.1.4.1.3 Pesticide Results

Five pesticides yielded sufficiently complete data sets for flux computations. 2,4 DDT yielded 11 samples with detectable concentration levels, 4,4 DDT yielded 9 samples with detectable concentration levels, Dieldrin yielded 8 samples with detectable concentration levels, Hexachlorobenzene yielded 11 samples with detectable concentration levels and Mirex yielded 6 samples with detectable concentration levels. Again, as with PCBs, the partial data sets consisted of consecutive sample detects following initial non-detects in all series except for Mirex. Mirex had a one sample data gap in an otherwise consecutive series. And again, the non-detects were removed from the data series for flux computations. One additional measurement (sample 6) of the Hexachlorobenzene data set was removed because it exceeded all other data in the set by an order of magnitude and introduced a large trend offset. Four of the five pesticides exhibited a positive trend in concentration over time (i.e. sediment *release*) and one, Dieldrin, exhibited a negative trend (i.e. sediment *uptake*). There were insufficient blank test samples with detectable concentrations of these five pesticides to compute comparable blank flux performance. All changes in pesticide concentration over the 70hour test were less than 2 ng/L (parts per trillion) with the largest change (approximately 1.8 ng/L) exhibited by 2,4'-DDT. Appendix D ("PC Organics Demo-Pesticides.xls") includes time-series graphs showing flux and blank tests concentrations over time for the five

pesticides with detectable concentrations. These graphs show reasonable linearity of the time-series flux with consideration of the very low concentrations measured.

5.1.4.2 Interpretation of Paleta Creek Organics Results

Whereas the flux results for the lighter molecular weight PAHs indicate greater mobility from the sediment into the overlying water than the heavier compounds, the measured concentration of the heavier molecular weight PAHs in samples extracted from the bulk sediment were generally higher than those of the lighter compounds. It appears that the heavier molecular weight PAHs are significantly less mobile, even with higher concentrations in the bulk sediment, than the lighter compounds. Comparison of this finding with solubility measurements of the targeted PAHs in seawater shows the same trend: the heavier molecular weight PAHs are far less soluble. A unilateral reduction in solubility of approximately five orders of magnitude occurs from lightest-to-heaviest for the 16 targeted PAHs. This relationship between PAH flux and PAH solubility does not appear to be exclusive of other factors however. For example, Pyrene (a four-ring compound with a molecular weight of 202) had a flux rate of 952ng/m^2/day which is more than twice that of Naphthalene (a two-ring compound with a molecular weight of 128) with a flux rate of 459ng/m^2/day. This result is likely driven by the bulk sediment concentration of Pyrene which was about of 57 times larger than Naphthalene (740ng/g vs 13ng/g). It appears that the flux of a PAH from the sediment into the overlying water remains dependant, in part, on the level of bulk concentration in the sediment. Thus even a low mobility, heavier molecular weight PAH with a high enough concentration in the sediment may flux into the overlying water at a higher rate than a lighter compound at lower concentrations. For the Paleta Creek test, it appears that the generally higher sediment concentrations of the heavier targeted PAHs were still too low to produce measurable concentrations. This then suggests that for PAHs in sediments, the PAH flux will vary in direct proportion to molecular weight and solubility leading to preferential removal of low molecular weight PAHs, and a relative increase in the bulk sediment fraction of the heavy molecular weight PAHs. Reduction of PAH concentrations at the sediment surface due to these diffusive fluxes will lessen, over time, the concentration levels of PAHs available for biological uptake. This reduction when combined with other natural attenuation factors such as infaunal irrigation and bacterially mediated degradation may be considered as a possible strategy for sediment remediation. Providing that risk levels are not exceeded, flux results for PAHs can be used to estimate the time required to reduce bulk sediment concentrations in the biologically active region of the sediment to acceptable levels.

The above discussion also generally applies to PCBs. The mobility of PCBs as indicated by the flux results was generally in direct proportion to solubility and in inverse proportion to molecular weight. The concentration values for the overlying water and bulk sediment were also generally consistent with trends identified with PAHs. The very low concentration levels of the PCBs in the Paleta Creek sediments introduced considerable uncertainty but a general trend is evident.

Pesticides may behave as above, however molecular weight relationships are difficult to establish with the wide range and complexity of such compounds. And, as with PCBs, the low concentration levels measured in this test introduce considerable uncertainty but still allow identification of a general trend.

5.1.4.3 Conclusions for Paleta Creek Organics Demonstration Test

The measurement of the mobility of organic compounds from contaminated sediments at the Paleta Creek location within Naval Station San Diego was successfully achieved. The measurements, when compared to triplicate blank test results resulted in quantification of statistically significant values with high confidence primarily for Polynuclear Aromatic Hydrocarbons (PAHs) fluxing into

overlying water. The complete range of targeted PAHs, Polychlorinated Biphenyl (PCB) Congeners and pesticides were not measured either because they were not present or because they were below analytical detection limits. PCBs and pesticides, where present and measurable, had very low concentrations which introduced significant data scatter and low statistical confidence levels. Some flux measurements of PCBs and all pesticides did not have blank test results for comparison. Future site measurements of known or suspected contaminants for which blank test results are not available would benefit from blank tests using spiked concentrations of targeted contaminants.

5.1.5 Pearl Harbor, Hawaii Metals Demonstrations

70-hour metals demonstrations using BFSD2 were conducted at two different sites in Pearl Harbor, Oahu, Hawaii during February 1999. The BFSD2 deployments were conducted as part of a combined demonstration with integrated sediment investigation technologies and included site screening prior to both BFSD2 deployments.

The first test was conducted Feb. 5-8, 1999 within the Naval Inactive Ship Mooring Facility (NISMF) at Middle Loch where approximately 70 moored ships await disposition (disposal, sale, temporary storage, etc.). The area is quiescent and approximately 26 feet deep with murky water and fine-grained sediment overlain with an easily disturbed 1-2 foot flocculent layer. Reports of sediment depths over 100 feet were not confirmed but are believable. Some benthic organisms were found in the sediment during screening. All work at the site was accomplished from an open-deck, 35-foot Navy workboat operated by enlisted personnel, see Figure 47. A portable generator was used to power the video monitor, underwater light and laptop computer during deployment, however for recovery all electrical connections were made after reaching the shore facility.

Figure 47. BFSD2 Pearl Harbor, Middle Loch Metals Demonstration.

The second metals test was conducted Feb. 11-14, 1999 within the area known as Alpha Docks, Marine Diving and Salvage Unit One (MDSU-1) located at Bishop Point on the entrance channel to the harbor, Figure 48. Again, historical, RI and screening data indicated elevated levels of trace

metals present in the sediment. This area is an active industrial location and included several Navy housing barges, which are moved about by tugboats. The area has a depth of approximately 25 feet with generally clear water and medium- to fine-grained sediments. Tidal currents are enough to minimize any flocculent layer. Some benthic organisms were found during sediment screening. The Navy workboat was used as before for deployment but because of proximity to the quay wall recovery was accomplished from shore using an 80-foot crane.

Figure 18. BFSD2 Pearl Harbor, Bishop Point Metals Demonstration.

Prior to both tests, the BFSD2 was cleaned and prepared using the same procedures used during triplicate metals blank tests as well as other deployments and demonstrations. For the first deployment at NISMF, Middle Loch cleaning was accomplished at SSC SD prior to loading the BFSD2 into its re-usable shipping container, Figures 49 and 50. The shipping container, designed for compatibility with commercial air cargo carriers, includes compartments, shelving and storage bays sufficient for shipment of BFSD2 as well as all materials and supplies required for extended field operations. Shipping weight was approximately 1450 pounds. For safety reasons the compressed oxygen cylinder was vented to less than 250 psi and no hazardous materials (i.e. Nitric Acid for cleaning and sample preservation) were air-shipped. The container proved convenient for onsite access and minimized working space requirements. After arrival and unpacking, system checks and oxygen bottle refilling operations preceded. Nitric acid was secured from the local Navy environmental laboratory.

Figure 49. BFSD2 Container, Front View.

Figure 50. BFSD2 Container, Back View.

Aboard the Navy workboat, after loading and connecting various equipment (laptop computer, TV monitor and light, cabling) to the portable generator, a standard pre-deployment checklist was followed. At the site, after tying off, lowering the bow platform and logging the GPS location, the BFSD2 was lowered by hand wench to near the bottom and either slowly lowered into the sediment (to minimize disturbance and maintain video coverage: as at Middle Loch) or released from about 2 feet for free-fall (to assure insertion when video coverage can be maintained as at Bishop Point). Activation of the battery-powered insertion lights by switches mounted on the chamber at the 3- inch level was verified and used to establish adequate sediment insertion. Once on the bottom a 15-minute program was started to stabilize the flow-through sensors and to measure the ambient

dissolved oxygen level. After entering the dissolved oxygen control limits into the 70-hour test program, downloading and verifying it, the test was started after visibility conditions for lid closure were confirmed. After starting the program, lid closure (which also activates #1 sample bottle) was viewed and commands for circulation pump activation (at 10 minutes) and sample valve activation (at 16 minutes) for sample bottle number two was monitored before disconnecting for autonomous operations. The disconnected cables were plugged, coiled and cast overboard in a direction away from the BFSD2. Both demonstration deployments were straightforward and without problems. For both tests, the BFSD2 was returned to the shore facility for all data recovery. After freshwater washdown and cleanup the twelve 250 ml sample bottles were removed for processing using EPA handling and chain of custody procedures. Pre-acidified 125ml containers were filled and capped, labeled, logged and refrigerated for subsequent analytical laboratory metals analysis. The remaining sample volume was used to measure silica concentrations with the field portable Hach model DR2010 Instrument. The silica concentrations plotted against time and the BFSD2 pH and dissolved oxygen sensor data, also plotted against time were reviewed for any possible sample compromise prior to shipment to the analytical laboratory. Tables 12 and 13 summarize the results of the Pearl Harbor Middle Loch and Bishop Point metals demonstrations.

Table 12. BFSD2 Results for Pearl Harbor Middle Loch (PHML**) Metals Demonstration.**

Metal	Flux ($\mu g/m^2/day$)	+/- 95% C.L. ($\mu g/m^2/day$)	Flux rate Confidence (%)	Triplicate Blank Flux ($\mu g/m^2/day$) Average	+/- 95% C.L.	Bulk Sediment ($\mu g/g$)	Overlying Water ($\mu g/L$)
Copper (Cu)	14.79	3.46	99.9%	2.82	8.73	195	0.80
Cadmium (Cd)	1.80	0.31	100.0%	-0.52	0.75	0.2	0.02277
Lead (Pb)	-0.12	0.43	95.2%	3.16	1.59	34	0.03879
Nickel (Ni)	27.17	15.91	100.0%	10.28	7.34	214	0.9472
Manganese (Mn)	-468.18	683.35	97.9%	-264.85	7.49	1180	52.19
Manganese (Mn)[1]	2131.59	904.57	100.0%	-264.85	7.49	1180	52.19
Zinc (Zn)	49.74	17.25	93.5%	-3.38	65.22	314	2.28
Other							
Oxygen (O_2)* (*$ml/m^2/day$)	-1085.52	64.84	na	na	na	na	4.17
Silica (SiO_2)* (*$mg/m^2/day$)	65.03	42.43	100%	-1.97	2.88	na	1.19

1. Mn flux calculated on the basis of first five samples due to non-linearity

Table 13. BFSD 2 Results for Pearl Harbor, Bishop Point (PHBP) Metals Demonstration.

Metal	Flux ($\mu g/m^2/day$)	+/- 95% C.L. ($\mu g/m^2/day$)	Flux rate Confidence (%)	Triplicate Blank Flux ($\mu g/m^2/day$) Average	Triplicate Blank Flux +/- 95% C.L.	Bulk Sediment ($\mu g/g$)	Overlying Water ($\mu g/L$)
Copper (Cu)	112.46	17.60	100.0%	2.82	8.73	241	0.36
Cadmium (Cd)	1.85	1.96	99.4%	-0.52	0.75	0.3	0.009
Lead (Pb)	0.71	1.11	78.7%	3.16	1.59	93	0.06519
Nickel (Ni)	21.04	15.41	96.3%	10.28	7.34	42.9	0.3934
Manganese (Mn)	223.33	284.79	100.0%	-264.85	7.49	324	1.78
Manganese (Mn)[1]	2177.45	192.60	100.0%	-264.85	7.49	324	1.78
Zinc (Zn)	191.18	54.07	100.0%	-3.38	65.22	304	1.43
Other							
Oxygen (O_2)* (*$ml/m^2/day$)	-567.12	54.96	na	na	na	na	6.5
Silica (SiO_2)* (*$mg/m^2/day$)	118.61	27.62	100%	-1.97	2.88	na	0.31

1. Mn flux calculated on the basis of first three samples due to non-linearity

Numbers in the Flux Rate Confidence column indicate the statistical confidence that the measured flux rate is different than the blank flux rate. Results from the blank study, bulk sediment analysis, overlying water and oxygen uptake analysis are shown for comparison.

The results for Middle Loch indicate that Copper, Cadmium, and Nickel had fluxes out of the sediment that were highly significant when compared to the blank chamber results. Zinc also showed an outward flux but the statistical confidence was somewhat lower, and compared to blank results, any zinc flux is inconclusive. Lead had a negative flux (sediment uptake) but the statistical confidence was again somewhat lower. The flux of Manganese was negative when calculated using all the samples, but was positive when using only the first five samples. After the first five samples, the Manganese concentration in the chamber dropped dramatically. The reason for this drop is not known, and this effect and subsequent handling of the data are discussed in the Paleta Creek discussion in Section 5.1.3.1. The Silica flux was out of the sediment and was highly significant when compared to blank results. Dissolved Oxygen indicated a sediment uptake.

The results for Bishop Point were significantly different than those of Middle Loch with the exception of Cadmium, which was nearly identical. Copper, Cadmium, Manganese and Zinc all had fluxes out of the sediment that were highly significant when compared to the blank chamber results and the magnitude of the Copper and Zinc fluxes were markedly higher than those observed for Middle Loch. The Nickel flux however was somewhat less and with a reduced confidence. Lead fluxed outward at Bishop Point, but confidence is only marginal when compared to blank chamber results. As with Middle Loch, the Manganese flux at Bishop Point was non-linear and the concentration in the chamber leveled off after the third sample. The Manganese flux calculated using only the first three samples is similar to the flux estimated using the first five samples at Middle Loch and similar to that measured at other sites. The flux calculated using all the samples is low but still positive. The Silica flux results were again highly significant compared to blank results and were

higher than Middle Loch. The Dissolved Oxygen sediment uptake was about half that of Middle Loch. Figures 50 and 51 belographically illustrate results

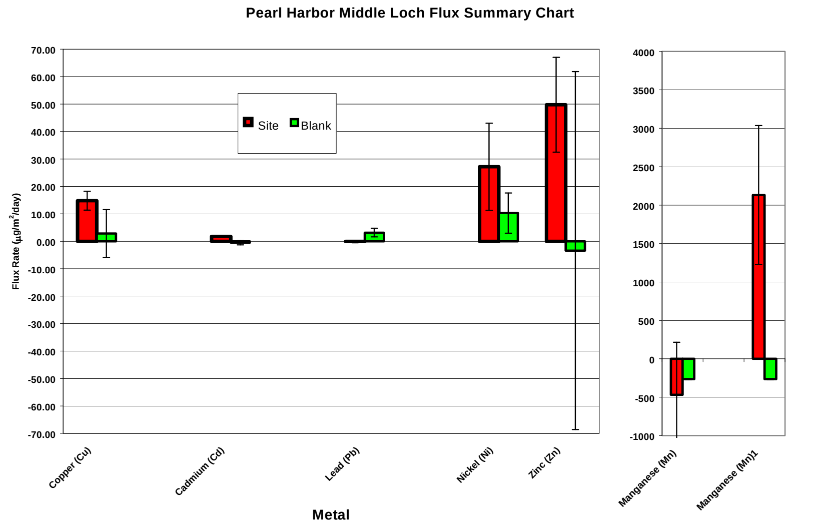


Figure 51. Pearl Harbor Middle Loch Demonstration Results.

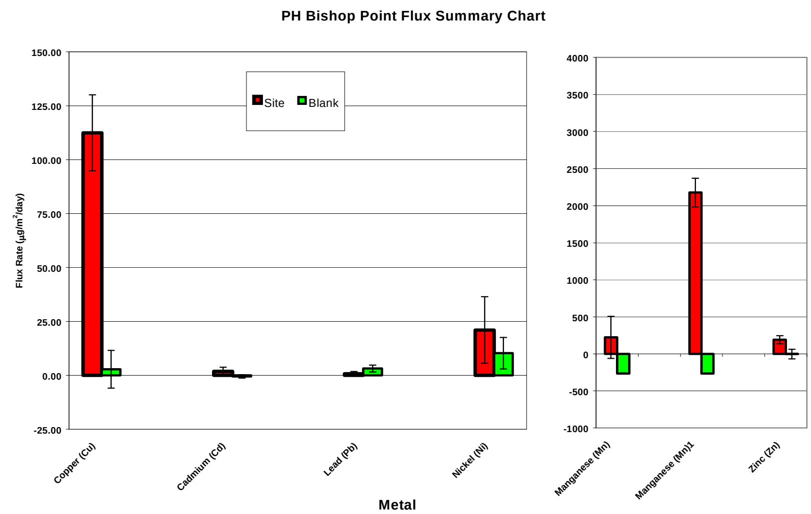


Figure 52. Pearl Harbor Bishop Point Demonstration Results.

5.1.5.1 Discussion of Pearl Harbor Metals Demonstrations Results

In general, BFSD2 results from the two Pearl Harbor demonstration locations were significantly different than one another. Figures 53 and 54 are the sets of graphs of concentration versus time for each analyte in each of the demonstrations, compared with blank performance. The results for the Middle Loch demonstration indicate that Copper, Cadmium, and Nickel had fluxes out of the sediment that were highly significant when compared to the blank chamber results. Zinc also indicated an outward flux but the statistical confidence was low suggesting no conclusive flux rate. Zinc concentrations in Middle Loch were low compared to other sites and most likely not a problem

in this area. Lead had a negative flux (sediment uptake) but the statistical confidence was again somewhat lower. Manganese flux trends were similar to those observed in Paleta Creek and discussed in Section 5.1.3.1. The flux of Manganese was lower, even negative, when calculated using all the samples, but was positive when using only the first five samples. After the first five samples, the Manganese concentration in the chamber dropped dramatically. The Silica flux was out of the sediment and was highly significant when compared to blank results. Dissolved Oxygen indicated a sediment uptake.

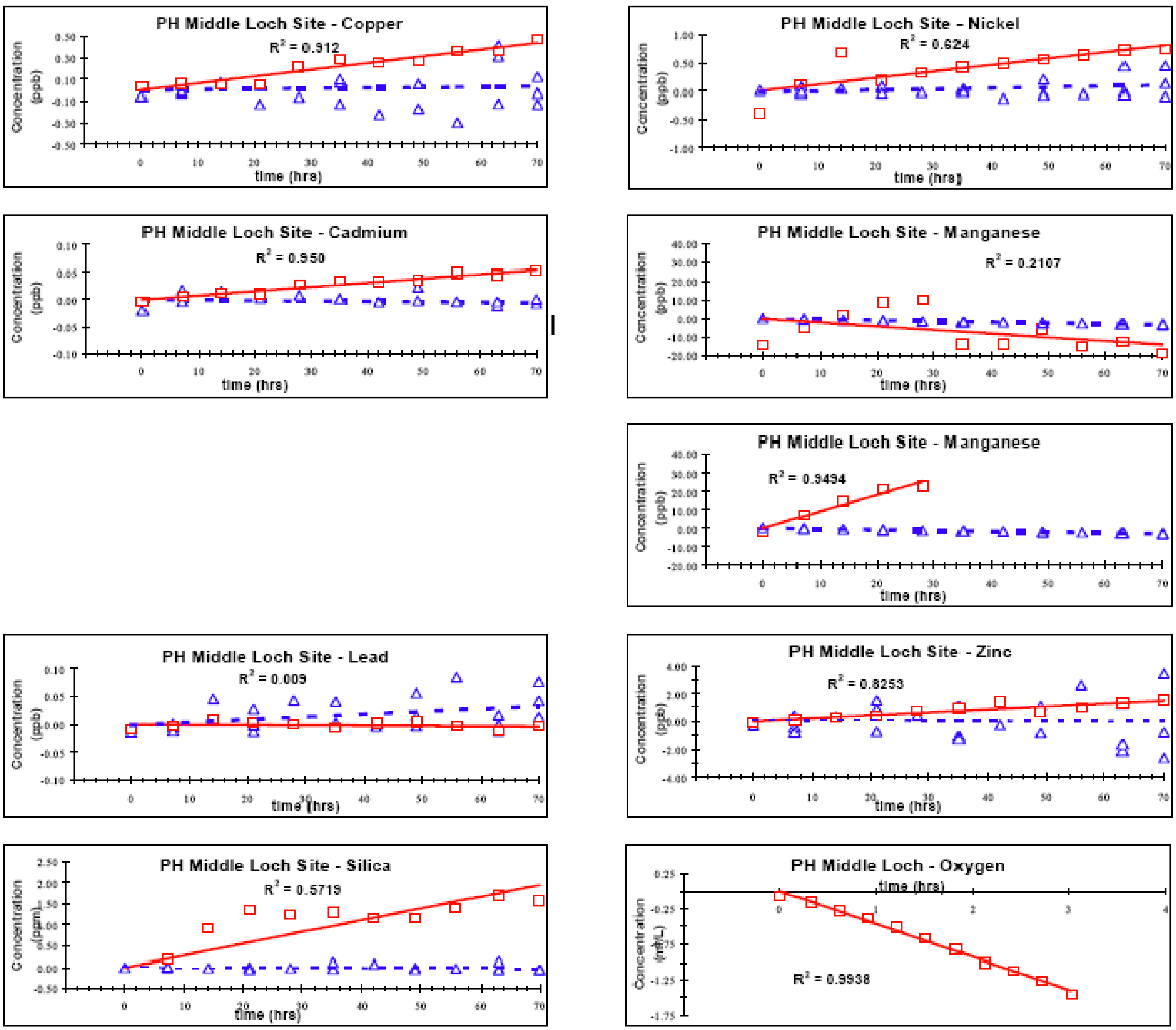


Figure 53. Pearl Harbor Middle Loch Demonstration Concentration vs. Time.

The results for Bishop Point were significantly different than those of Middle Loch with the exception of Cadmium, which was nearly identical. Copper, Cadmium, Manganese and Zinc all had fluxes out of the sediment that were highly significant when compared to the blank chamber results and the magnitude of the Copper and Zinc fluxes were markedly higher than those observed for Middle Loch. The Nickel flux however was somewhat less and with a reduced confidence. Lead

fluxed outward at Bishop Point, but confidence is only marginal when compared to blank chamber results. As with Middle Loch, the Manganese flux at Bishop Point was non-linear and the concentration in the chamber leveled off after the third sample. The Manganese flux calculated using only the first three samples is similar to the flux estimated using the first five samples at Middle Loch and similar to that measured at other sites. The flux calculated using all the samples is low but still positive. The Silica flux results were again highly significant compared to blank results and were higher than Middle Loch. The Dissolved Oxygen sediment uptake was about half that of Middle Loch.

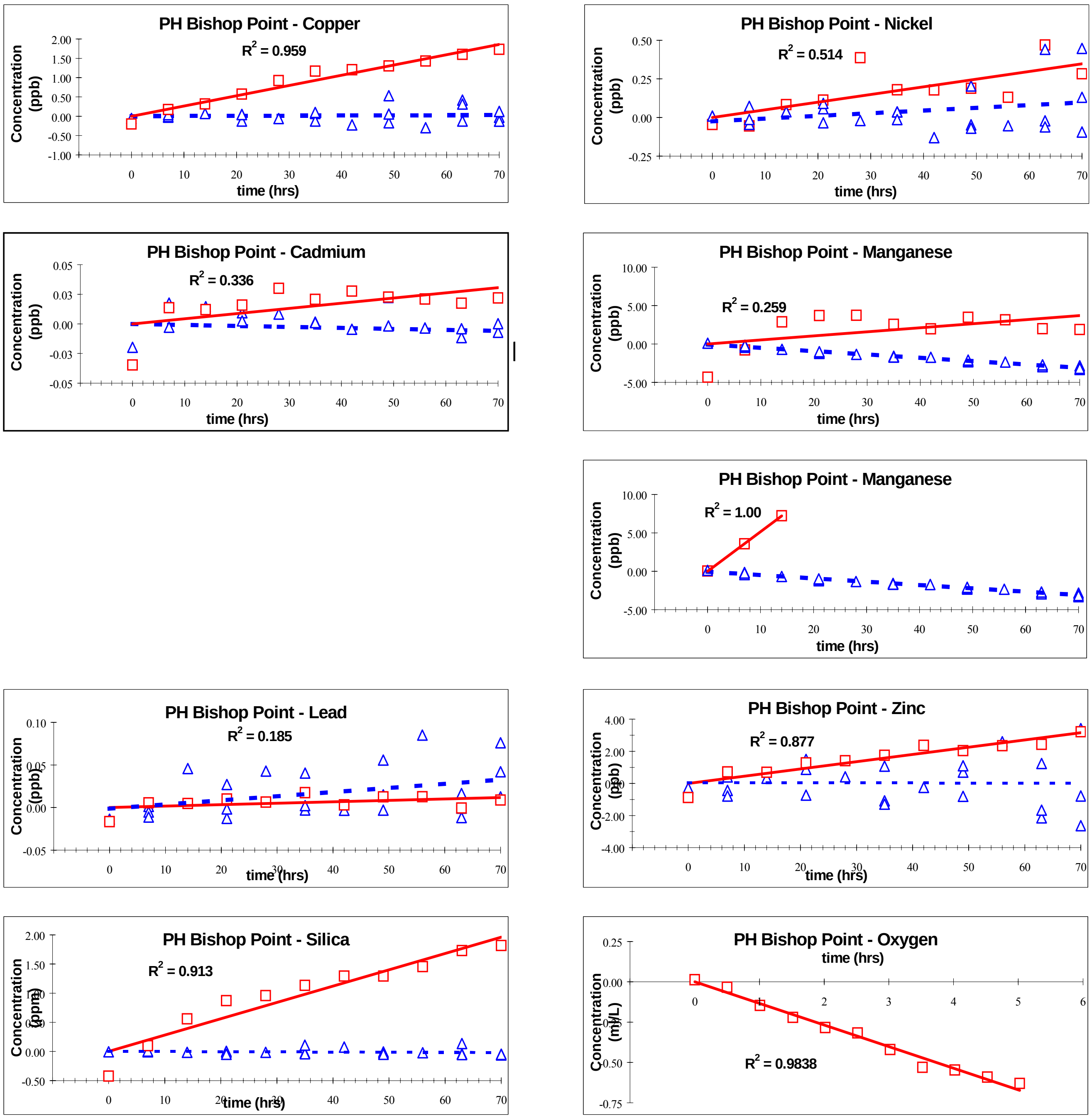


Figure 54. Pearl Harbor Bishop Point demonstration Concentration vs. Time.

5.1.5.1.1 Metals Flux Measurements

Flux measurements were made for the metals cadmium, copper, lead, nickel, manganese and zinc. As shown in Tables 12 and 13, and illustrated in Figures 51 through 54, the BFSD2 results from the two Pearl Harbor demonstrations were significantly different from one another and from previous surveys.

Middle Loch fluxes were lower than those of Bishop Point, with the exception of Nickel (which was slightly higher). Of interest is that the Manganese flux at Middle Loch was initially almost the same (during the first 28 hours) as that at Bishop Point during the first 14 hours and then both exhibited an abrupt downward change. Possible explanations for this observation include complex reduction-oxidation interactions, sulfide binding, complexation with organic matter, or elevated water column concentrations associated with hull leachate sources at the sediment interface. The concentration-time graphs for both Manganese and Silica at Middle Loch show similar "quenching" trends, which are also apparent to a lesser degree in comparable data from Bishop Point.

Bishop Point fluxes were all outward and larger in magnitude than Middle Loch (except Nickel, as mentioned above). Copper, Cadmium, Manganese and Zinc all had fluxes out of the sediment that were highly significant when compared to the blank chamber results and the magnitude of the Copper and Zinc fluxes were markedly higher than those observed for Middle Loch. The Nickel flux however was somewhat less and with a reduced confidence. Lead fluxed outward at Bishop Point, but confidence is only marginal when compared to blank chamber results. With consideration for the more subtle Manganese and Silica "quenching" trends and the relatively lower oxygen uptake rate at Bishop Point, the fluxes appear to be less affected by possible interactions and are mobilizing from the sediment more linearly. The larger sediment grain sizes and size distribution at Bishop Point, as determined during site screening, may also be contributing to the apparent linear mobility of the outward fluxing metals.

As with Middle Loch, the Manganese flux at Bishop Point was non-linear and the concentration in the chamber leveled off after the third sample. The Manganese flux calculated using only the first three samples is similar to the flux estimated using the first five samples at Middle Loch and similar to that measured at other sites. The flux calculated using all the samples is low but still positive. The Silica flux results were again highly significant compared to blank results and were higher at Bishop Point than Middle Loch. The Dissolved Oxygen sediment uptake at Bishop Point was about half that of Middle Loch.

5.1.5.2 Discussion of Pearl Harbor Metals Demonstration Tests

Important aspects of the demonstrations including performance indicators and deployment problems are discussed below.

5.1.5.2.1 Performance Indicators

As discussed in Section 5.1.2.2.1, several methods were used to assure system performance of the BFSD 2 during and after the demonstrations. In both deployments the landing and insertion, monitored with the video camera and landing lights, indicated a good penetration and after the test was started, the video camera also confirmed successful lid closure. At Middle Loch the "soft" landing approach was used to minimize disturbance of the flocculent layer and maintain maximum visibility in the already murky water. Penetration was about twice normal (approximately 6 inches) and all visibility was lost. Test start and lid activation was delayed (about 15 minutes) until the water cleared enough to confirm closure. At Bishop Point a "free fall" landing approach was used from

about one foot above the sediment without significant loss of visibility. The resulting outward-traveling small cloud of disturbed sediment clearly showed the "low bow-wave" design of the BFSD2 to function effectively. The color underwater video camera made viewing this performance possible.

A monotonic increase in silica during the demonstrations was used as another indicator of proper system performance and chamber seal. As shown in Figures 50 and 51, for both deployments the silica concentration increased over the duration of the test indicating proper system performance and chamber seal. The flux magnitudes were high compared to previous mainland surveys, and may be explained by the tropical conditions (i.e., calciferous-rich). Bishop Point Silica results were reasonably linear, but Middle Loch Silica flux was not. Following a rate of increase during the first 24 hours of almost twice that of Bishop Point, Middle Loch Silica flux slowed significantly for the remainder of the test. The non-linearity in both Silica and Manganese fluxes suggest that as the concentrations in the chamber build, the fluxes may be altered by the presence of the chamber itself. This could be attributed either to time/concentration dependent reactions within the chamber, or changes in fluxes due to changes in the gradient between the porewater and the overlying water trapped within the chamber.

The Dissolved Oxygen level in the chamber was monitored and recorded to assure maintenance of ambient oxygen levels, proper chamber seal, and to evaluate sediment oxygen uptake. The rate of oxygen consumption (sediment uptake) during the deployments, was shown in Figures 53 and 54, and was sufficient to cause repeated cycling of the BFSD2 oxygen control subsystem. Figure 55 are graphs of the oxygen sensor data for the two deployments showing the operation of the control system. The control limits selected allowed the dissolved oxygen to remain within approximately 1 ml/L of the ambient level and still yield data to assess the sediment uptake rate. Functioning of the system in this manner assured that chamber isolation of the water was maintained. The ambient oxygen level at Middle Loch was about one half that of Bishop Point and the sediment uptake rate was about twice that of Bishop Point. These conditions, when combined with the pH results discussed below indicate Middle Loch has a higher level of organic decomposition. Again, this is reasonable when considering the differences between the sites.

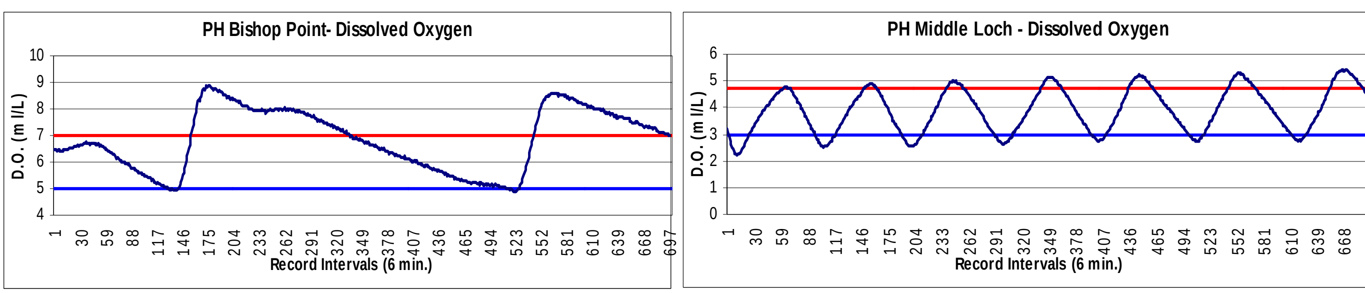


Figure 55. Pearl Harbor Demonstrations Oxygen Control Results.

The pH level in the chamber was monitored and recorded as another assurance indicator of seal integrity. In a sealed BFSD2 chamber, the pH will generally show a decreasing trend as the breakdown of organic matter at the sediment water interface drives CO_2 into the chamber water. This decreasing trend was observed during both deployments as shown in Figure 56. And, as would be expected from results of oxygen uptake discussed above, the pH level dropped at a higher rate throughout the entire 70-hour test duration at Middle Loch.

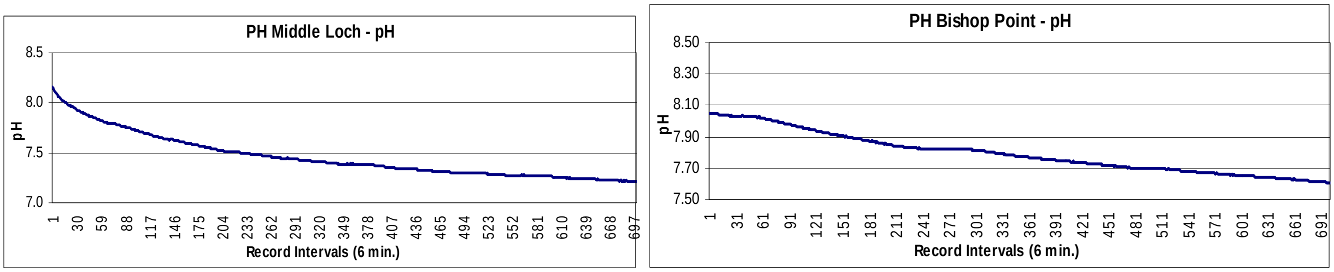


Figure 56. Pearl Harbor Demonstrations pH Results.

5.1.5.2.2 Deployment and Recovery Problems

One minor problem was encountered during recovery at the Middle Loch demonstration and no deployment problems were encountered at either site and. At Middle Loch the commercial acoustic recovery system failed to function following several transmissions of the coded signal. Diver assistance was required to deploy the marker buoy and routine recovery operations were then followed. Subsequent analysis indicated absorption of the acoustic energy by the sediment due to the depth of BFSD2 insertion (almost covering the acoustic receiver window) and a near overhead aspect during transmission. Use of a standoff distance from the approximate location of the BFSD2 for future tests will minimize reoccurrence. Buoy activation was normal (within 8 minutes) after the Bishop Point deployment.

5.1.5.3 Discussion of Metals Data Interpretation

Although the measurements from Pearl Harbor are limited to two locations, they provide significant insight into the importance of understanding contaminant mobility. One way to interpret the flux chamber measurements for Pearl Harbor is to evaluate them in the context of the exposure pathways defined in the RI study. In the RI study, sight-specific Biota-to-Sediment Accumulation Factors (BSAFs) were developed by comparing the tissue burdens of wild-caught organisms to the sediment concentrations found in the same region. In this approach, 100% of the tissue burden is attributed to sediment exposure. One of the primary pathways of sediment exposure is thought to be via remobilization of chemicals to the dissolved phase and subsequent uptake by the organism. The results from the flux chamber measurements allow us to quantify and examine this key pathway.

As an example, we can consider the potential exposure for copper in sediments at the two sites. A cursory examination of the bulk sediment data in Tables 7 and 8 indicate that the exposure levels at the two sites would be about the same, with a slightly lower level at Middle Loch than at Bishop Point. Thus the predicted bioaccumulation for the two sites would also be similar. However, examination of the flux rates for copper at the two sites suggests a much different scenario. The flux rate of copper at Middle Loch was much lower than the flux rate measured at Bishop Point. This indicates that the bulk sediment levels at the two sites do not necessarily reflect the exposure potential. This is further supported by evaluation of the bulk sediment data on a scale normalized for iron content. This analysis indicates that while the levels of copper at Middle Loch fall along the ambient trend, the copper levels at Bishop Point have sources of copper beyond that available from background weathering as shown in Figure 57. In addition, the high oxygen uptake rates at Middle Loch indicate presence of reducing sediments that are likely to contain strong copper binding phases such as sulfides.

These results suggest consideration of a refined exposure model for organisms where the primary exposure is thought to be via the dissolved phase. For example, using the measured flux rates for

copper, the contribution of the sediments to the water can be estimated. This would then be used to quantify the fraction of the biological exposure that could be attributed to this pathway. If this exposure mechanism cannot account for observed uptake or effects, then other pathways or sources must be considered.

Thus the flux rate measurements at the two Pearl Harbor sites illustrate the usefulness of the system in identifying and quantifying exposure pathways between sediments and organisms. The flux results are also consistent with existing knowledge of sediment geochemistry. The results suggest that incorporation of flux measurements on a broader scale will help to improve ecological risk assessments by providing stronger links between bulk sediment chemistry and biological exposure

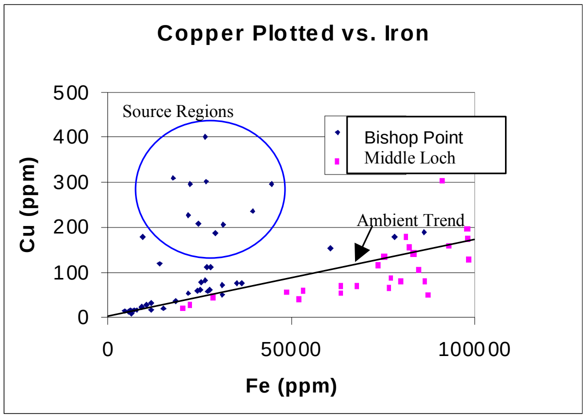


Figure 57. Pearl Harbor Demonstration Data with Iron-Normalized Bulk Sediment Copper Concentrations.

5.1.6 Pearl Harbor, Hawaii Organics Demonstration

One 72-hour test to demonstrate the application of the Benthic Flux Sampling Device 2 (BFSD 2) in *organics*-contaminated sediments was conducted September 7-10, 2001. The test was conducted at the Navy's Marine Diving and Salvage Unit 1 (MDSU-1) facility located at Bishop Point, Pearl Harbor, Hawaii. Pearl Harbor is identified on the National Priority List (Super Fund) for environmental cleanup and is currently completing a four-year Remediation Investigation (RI) study. The site was selected based on RI results and field screening results conducted in February 1999. It had also been previously used for BFSD2 metals-contaminated sediment studies and provided excellent test conditions (access, support, facilities). The MDSU-1 area is an active industrial location and includes several Navy housing barges, which are periodically moved by tugboats. The area has a depth of approximately 25 feet with generally clear water and medium- to fine-grained sediments. Tidal currents are enough to minimize any flocculent layer. The Alpha Dock site selected is near the site used for the metals test and was close enough to the quay wall to allow both deployment and recovery from shore using an 80-foot crane (See Figure 58).

Figure 58. BFSD2 Pearl Harbor, Bishop Point Organics Demonstration.

The BFSD2 was cleaned and prepared at Space and Naval Warfare Systems Center, San Diego (SSC SD) using the same procedures used during triplicate blank tests and the first organics demonstration. It was then loaded into its re-usable shipping container for air-shipment to Hawaii. The shipping container, designed for compatibility with commercial air cargo carriers, includes compartments, shelving and storage bays sufficient for shipment of BFSD2 as well as all materials and supplies required for extended field operations. Shipping weight was approximately 1450 pounds. For safety reasons the compressed oxygen cylinder was vented to less than 250 psi and no hazardous materials were air-shipped. The container is convenient for onsite storage and access and minimizes working space requirements. After arrival and unpacking, system checks were performed to assure no degradation during shipment had occurred. Oxygen bottle refilling was a problem in that compressed-gas suppliers were not willing to fill the small SCUBA-type cylinder and recreational dive shops would fill it but didn't carry pure oxygen. The problem was resolved when vandals stole the tank and refill fittings from
the rental car trunk. A new, air-filled small dive tank was purchased as a replacement. It was recognized that the lower oxygen content of the compressed air would be marginal in maintaining ambient chamber conditions, however it was generally believed that the diffusive flux component of organic compounds are not dependant on dissolved oxygen levels. Test results were not anticipated to be affected by the use of compressed air.

At the site near the quay wall the crane was positioned with its lift lines measured to allow placement of the BFSD2 at the desired location. An electrical extension cord was connected to a nearby building to provide power for the various deployment equipment (laptop computer, TV monitor and cabling) located in the trunk of the rental car (Figure 59). Preparations for the deployment followed a standard pre-deployment checklist (Figure 60).

Figure 59. Deployment Equipment.

Figure 60. Pre-Deployment Checklist.

After the BFSD2 was lowered to within view of the sediment surface it was established that no obstructions to chamber penetration were present and the decision to deploy was made. The crane lowered the BFSD2 at its maximum descent rate and a good landing was observed with the underwater video monitor. The bottom landing created a minimal amount of sediment resuspension and the water cleared within 15 seconds.

After video confirmation of sufficient sediment penetration to achieve a sea l the 10minute sensor check program was initiated. This program activated closure of the chamber lid which, while closing, simultaneously opened a hinge-mounted valve to collect the ambient-condition water sample (bottle #1). Following lid closure and activation of the recirculation subsystem, measurements of the enclosed water for dissolved oxygen, pH, temperature, pressure and salinity were made and recorded at 6second intervals for 10 minutes. Following completion of the 10-minute program t he sensor data was uploaded, processed and entered into a custom data template to confirm sensor functions and to establish initial ambient water conditions. The measurement for ambient dissolved oxygen was used to establish limits for the BFSD2 oxygen control subsystem. These values were entered into the 72-hour flux test program and downloaded to the submerged BFSD2. The limits selected reflected the use of compressed air in place of pure oxygen and allowed a near anoxic lower threshold to be reached before activating the oxygen (i.e. air) recharge valve. Figure 61 shows the ambient dissolved oxygen measurement with the upper and lower control limits superimposed and Figure 62 shows the ambient pH measurement.

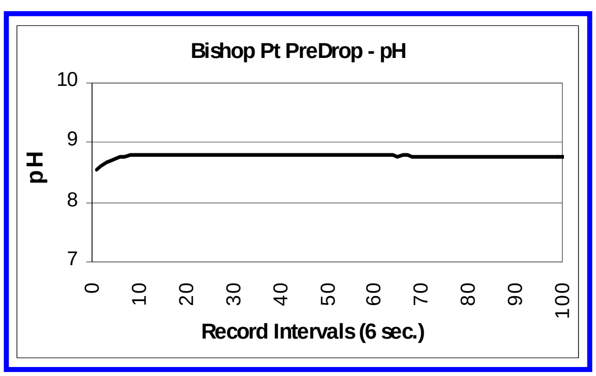


Figure 61. Ambient Dissolved Oxygen.

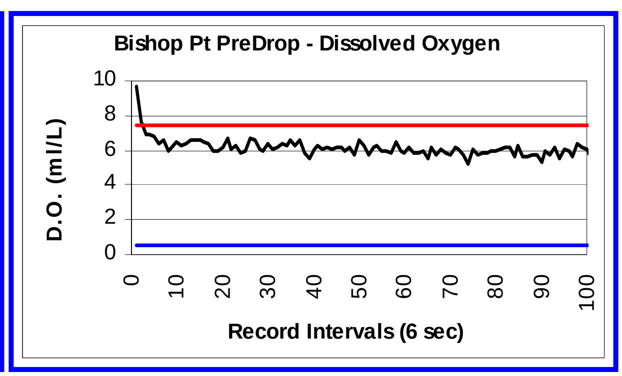


Figure 62. Ambient pH.

With the BFSD2 in place on the bottom, the downloaded 72-hour flux test program with the selected control limits was verified and the program was started. The BFSD2 connections were maintained to monitor and confirm collection of the first chamber sample (bottle #2) and sensor measurement recordings at 6-minute intervals. The crane tackle block was then disengaged from the deployment line and the crane was moved from the area. The deployment line and communication cables were stowed on the pier pilings to facilitate recovery at the completion of the 72-hour flux test.

At the conclusion of the 72-hour time period the BFSD2 communication cable was reconnected to the laptop computer to verify completion of the flux test program and to upload the recorded sensor data. The crane was then repositioned, rigged for recovery and the BFSD2 was lifted off the bottom and onto shore. Once secure on land an initial inspection indicated no damage, all components were intact and all twelve sample bottles were full. From a floating platform positioned over the deployment site a hand-held GPS location record was made and a 250-ml sediment sample was collected. The samples were then removed and transported to the field lab facility for filter removal, lid installation, labeling and preparation for shipment to the Arthur D. Little (ADL) analytical laboratory in Cambridge, MA. The BFSD2 was flushed and cleaned with freshwater, the gel-cell batteries were recharged and the sample collection subsystem was purged with deionized water and dried with forced-air in preparation for the return shipment to SSC SD.

As the samples were being processed, the recorded data files for the 72-hour test were uploaded and entered into a standardized Excel spreadsheet template for data processing. The sensor data, plotted as time-series indicated a successful deployment. As can be seen in Figure 63, there was no sudden pH level shifts indicating loss of chamber seal. The slowly reducing trend for pH level was normal and is indicative of biological activity. The dissolved oxygen level, Figure 64, shows the expected steady decline and control system activation as the level dropped below the lower limit. The decline was temporarily reversed, most likely due to residual pure oxygen in the system, however the recharge was not maintained due to the low oxygen content of the compressed air and the chamber eventually fell below the lower limit and remained at a near anoxic level until the test was completed. It is also noted that the slope of the declining pH became approximately level as the chamber approached anoxic conditions, indicating reduced biological activity. Salinity, temperature and pressure were normal.

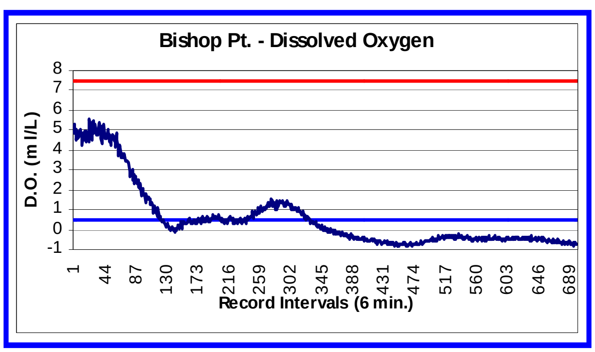


Figure 63. Chamber pH.

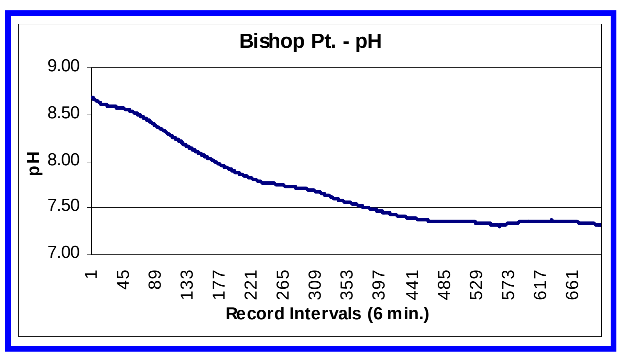


Figure 64. Chamber Dissolved Oxygen.

The samples were air-shipped from Honolulu International Airport by overnight express (FedEx) the afternoon of Sept 10, 2001. But the events of Sept 11, 2001 grounded all flights nation-wide and the samples were stopped and delayed in Oakland, CA until delivery to ADL on Sept 17, 2001. The samples were intact but exceeded the maximum extraction holding time (7 days) and maximum

storage temperature (4 degrees C.) when received. The conditions were noted and the decision to continue with processing and analysis was made.

5.1.6.1 Pearl Harbor Organics Demonstration Results.

Tables 14, 15 and 16 below provide a summary of the flux results for selected PAHs, PCB congeners and pesticides, respectively. Figures 65, 66, and 67 provide graphical comparison of the flux results with the blank tests results.

Table 14. Summary Results for PAHs.

PAH	Flux ($ng/m^2/day$)*	+/- 95% C.L. ($ng/m^2/day$)	Flux rate Confidence (%)	Triplicate Blank Flux ($ng/m^2/day$) Average	+/- 95% C.L.	Bulk Sediment (ng/g)	Overlying Water (ng/L)
9. BENZO(A)ANTHRACENE	75.00	306.84	NA	NA	NA	16,000	Non-Detect
10. CHRYSENE	1048.91	1012.25	98.5%	23.94	22.32	48,000	5.1
11. BENZO(B)FLUORANTHENE	919.89	375.56	99.8%	-134.30	297.91	36,000	6.2
12. BENZO(K)FLUORANTHENE	234.99	156.43	93.3%	-9.71	36.30	10,000	2.5
13. BENZO(A)PYRENE	Non-Detect	NA	NA	NA	NA	12,000	Non-Detect
14. INDENO(1,2,3-C,D)PYRENE	6.72	67.06	NA	NA	NA	7,400	1.6
15. DIBENZ(A,H)ANTHRACENE	Non-Detect	NA	NA	NA	NA	1,500	1.5
16. BENZO(G,H,I)PERYLENE	7.91	64.14	11.6%	20.15	65.15	5,300	1.7

PAH	Flux ($ng/m^2/day$)*	+/- 95% C.L. ($ng/m^2/day$)	Flux Rate Confidence (%)	Triplicate Blank Flux ($ng/m^2/day$) Average	+/- 95% C.L.	Bulk Sediment (ng/g)	Overlying Water (ng/L)
1. Naphthalene	-110.07	596.59	38.1%	-440.30	458.38	44	13
2. Acenaphthene	2680.41	10124.62	51.2%	-32.40	50.34	3,800	37
3. Acenaphthylene	627.85	1483.64	82.7%	208.47	112.60	1,200	5.6
4. Fluorene	75.17	1894.31	23.4%	-76.74	28.38	4,800	19
5. Phenanthrene	-552.72	1305.06	98.2%	10.95	10.95	54,000	32
6. Anthracene	4053.72	3094.52	100.0%	117.68	64.62	10,000	13
7. Fluoranthene	4435.81	10157.65	97.4%	-1423.95	178.41	270,000	52
8. Pyrene	38.99	4132.13	28.5%	-439.51	70.73	150,000	20

Table 15. Summary Results for PCBs.

PCB	Flux ($ng/m^2/day$)*	+/- 95% C.L. ($ng/m^2/day$)	Flux rate Confidence (%)	Blank Flux ($ng/m^2/day$) Flux	+/- 95% C.L.	Bulk Sediment (ng/g)	Overlying Water (ng/L)
101 - 2,2',4,5,5'-Pentachlorobiphenyl	-2.62	93.70	4%	57.59	31.49	Non Detect	2.1

Table 16. Summary Results for Pesticides.

Pesticide	Flux ($ng/m^2/day$)*	+/- 95% C.L. ($ng/m^2/day$)	Blank Flux ($ng/m^2/day$) Flux	+/- 95% C.L.	Bulk Sediment (ng/g)	Overlying Water (ng/L)
Mirex	61.81	110.60	NA	NA	Non Detect	1.00

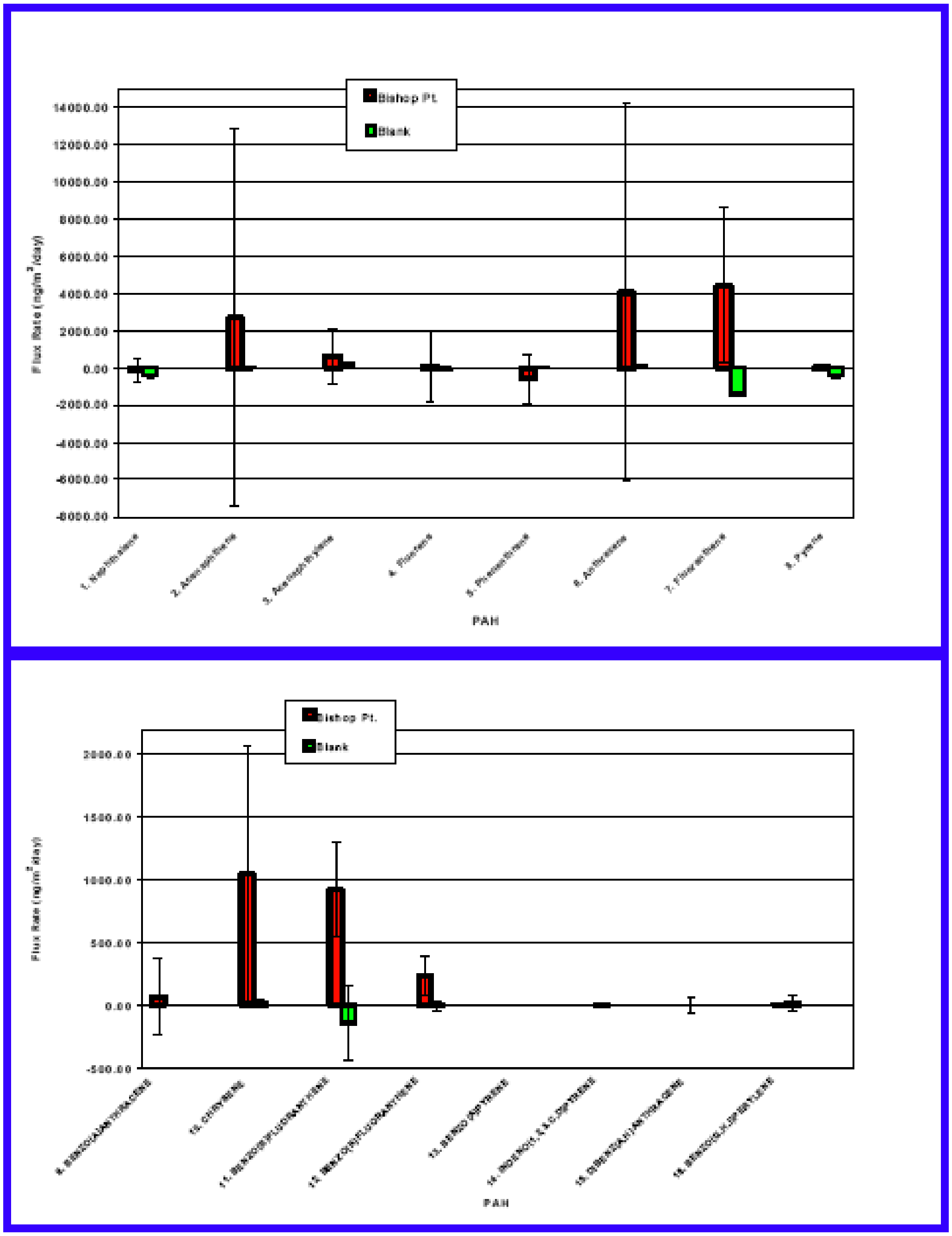


Figure 65. Flux to Blank Comparison for PAHs.

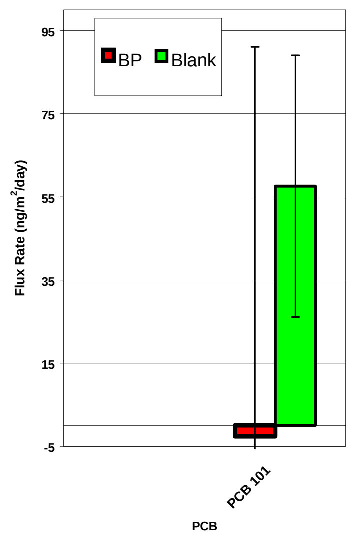


Figure 66. **Flux to Blank Comparison for PCBs.**

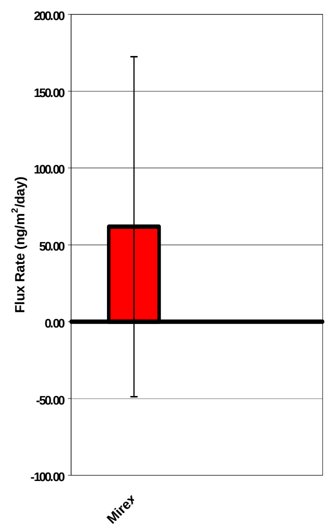


Figure 67. Flux to Blank Comparison for Pesticides.

5.1.6.1.1 Polynuclear Aromatic Hydrocarbons (PAHs) Results

Complete individual data sets were obtained for all of the first eight lighter molecular weight PAHs (Naphthalene, Acenaphthene, Acenaphthylene, Fluorene, Phenanthrene, Anthracene, Fluoranthene and Pyrene). Complete individual data sets were also obtained for five of the eight heavier molecular weight PAHs (Chrysene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Indeno(1,2,3-c,d)pyrene and Benzo(g,h,I)perylene). Partial data sets were obtained for Benzo[a]anthracene (9 of 12 detects) and Dibenzo[a,h]anthracene (4 of 12 detected). No detects were obtained for Benzo[a]pyrene. Flux analysis was accomplished for all complete data sets and the partial data set for Benzo[a]anthracene. However, the Benzo[a]anthracene analysis was abandoned since two of the

three non-detects occurred in the first four samples, as discussed below, and was compounded by a lack of blank test data for statistical comparison.

All trends in concentration change (i.e. flux) were strongly positive for the first four samples in each series of twelve. R^2 linearity factors for these initial trends were exceptionally high for all except Phenanthrene, Indeno(1,2,3-c,d)pyrene and Benzo(g,h,I)perylene. The concentration trends for the last eight samples in each series were generally flat or slightly negative with only Benzo(k)fluoranthene maintaining a lowered, but steady increase. R^2 linearity factors for these trends were correspondingly low. Due to this apparent change in concentration trends occurring after sample number four, coincident with the chamber dissolved oxygen level falling below the control limit at about 15 hours, separate analyses of the first four samples in each series and for the last eight samples in each series were accomplished. Also supporting this approach, the bulk sediment concentration levels for all the analyzed PAHs was directly related to the flux of the first four samples in the series and not for the last eight. And, whereas the relationship between bulk sediment concentrations and overlying water concentrations (measured in the number one sample) appear to be consistent with the solubility relationships discussed in the BFSD Paleta Creek demonstration report, the trend relationships identified for flux, bulk sediment concentrations and solubility appear to hold only for the first four samples. Table 17 shows these relationships for the first four PAH samples and Figure 68 shows the graphical comparison of the measured flux with the blank tests for the first four PAH samples.

Table 17. Summary Results for First Four PAH Samples.

PAH	Flux ($ng/m^2/day$)*	+/- 95% C.L. ($ng/m^2/day$)	Flux Rate Confidence (%)	Triplicate Blank Flux ($ng/m^2/day$) Average	Triplicate Blank Flux +/- 95% C.L.	Bulk Sediment (ng/g)	Overlying Water (ng/L)
1. Naphthalene	1,848	4,406	59.1%	-440.30	458.38	44	13
2. Acenaphthene	71,053	327,574	100.0%	-32.40	50.34	3,800	37
3. Acenaphthylene	6,862	14,388	100.0%	208.47	112.60	1,200	5.6
4. Fluorene	10,387	110,972	100.0%	-76.74	28.38	4,800	19
5. Phenanthrene	3,031	106,689	99.4%	10.95	10.95	54,000	32
6. Anthracene	26,955	27,293	100.0%	117.68	64.62	10,000	13
7. Fluoranthene	69,812	380,980	100.0%	-1423.95	178.41	270,000	52
8. Pyrene	24,512	190,722	100.0%	-439.51	70.73	150,000	20
9. BENZO(A)ANTHRACENE	Non-Detect	NA	NA	NA	NA	16000	Non-Detect
10. CHRYSENE	8792.74	10650.17	100.0%	23.94	22.32	48000	5.1
11. BENZO(B)FLUORANTHENE	3080.74	17862.21	99.4%	-134.30	297.91	36000	6.2
12. BENZO(K)FLUORANTHENE	977.52	3135.53	99.7%	-9.71	36.30	10000	2.5
13. BENZO(A)PYRENE	Non-Detect	NA	NA	NA	NA	12000	Non-Detect
14. INDENO(1,2,3-C,D)PYRENE	122.97	7141.99	NA	NA	NA	7400	1.6
15. DIBENZ(A,H)ANTHRACENE	Non-Detect	NA	NA	NA	NA	1500	1.5
16. BENZO(G,H,I)PERYLENE	33.19	5249.47	7.0%	20.15	55.15	5300	1.7

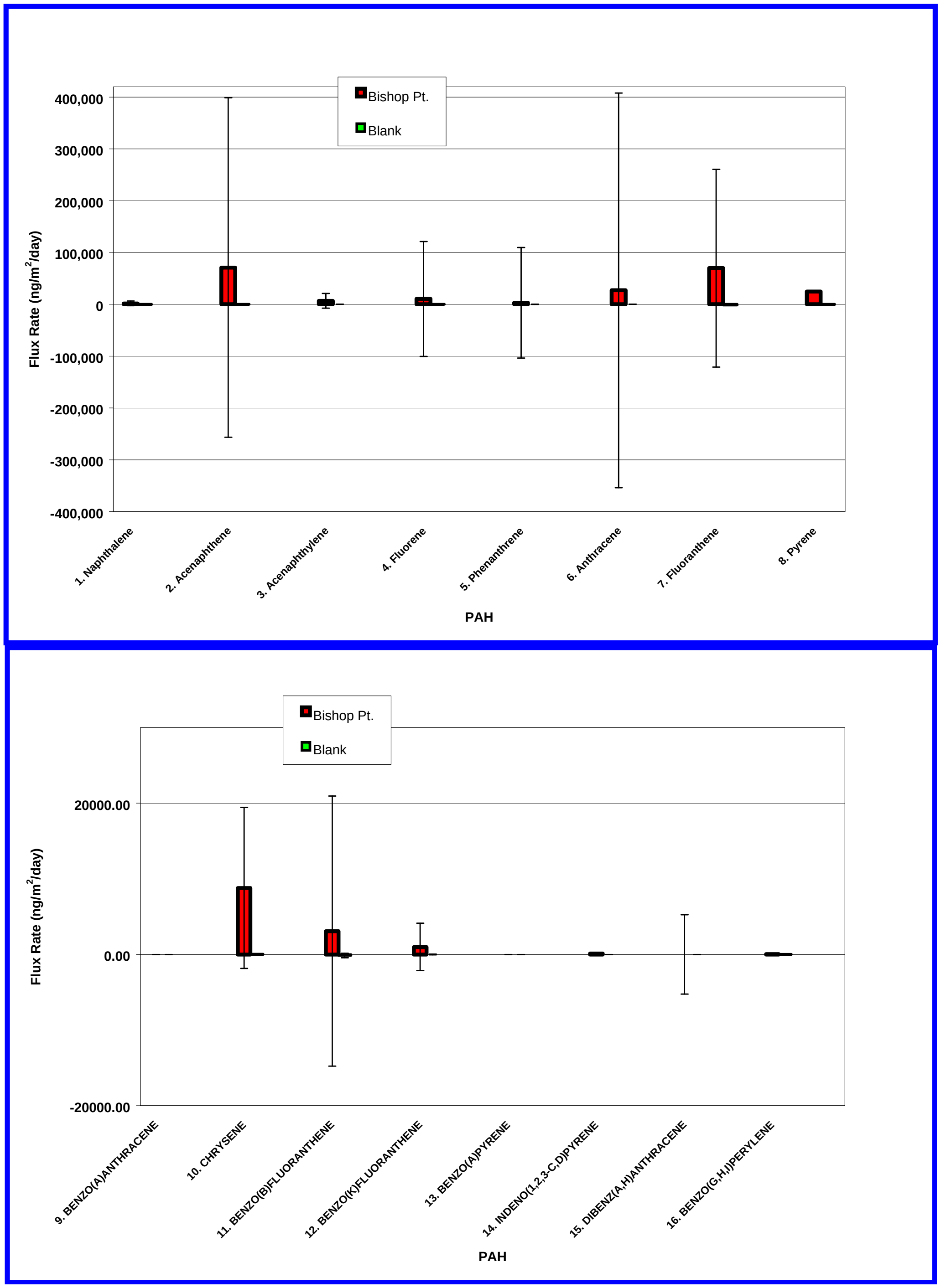


Figure 68. Flux to Blank Comparison for First Four PAH Samples.

The concentration trend (or flux) for the first four samples in the series, when compared to the statistically derived triplicate blank test trends showed large, significant flux for all of the eight lighter molecular weight PAHs. For seven of these eight PAHs the confidence that the flux was statistically different than the associated blank results was approximately 100%. The confidence for Naphthalene was 59.1%. For the five heavier molecular weight PAHs with complete data sets, the first four samples for Chrysene, Benzo(b)fluoranthene and Benzo(k)fluoranthene had high confidence (approximately 100%); Benzo(g,h,I)perylene had low confidence (7.0%); and

Indeno(1,2,3-c,d)pyrene had insufficient blank test data for comparison. For all the analyzed PAHs except Anthracene of the lighter molecular weight PAHs, and Benzo[b]fluoranthene and Benzo[k]fluoranthene of the heavier molecular weight PAHs, the last eight samples in the series exhibited concentration trends with low and/or negative trends as well as low confidence levels when compared to blank test results. Appendix D ("BP Organics Demo-PAHs.xls") includes time-series graphs showing flux and blank tests concentrations over time for the PAHs. Graphs for the complete data sets (12 samples), for the first four samples and for the last eight samples allow comparison of the flux and blank test results.

5.1.6.1.2 Polychlorinated Biphenyl (PCB) Congeners Results

One complete individual data set was obtained for PCB Congener number 101 (2,2',3,4,4',5,5'-Heptachlorobiphenyl). Partial data sets were obtained for ten PCB Congeners: number 8 (2,4'-Dichlorobiphenyl) with 2 of 12 detections; number 44 (2,2',3,5'-Tetrachlorobiphenyl) with 5 of 12 detections; number 52 (2,2',5,5'-Tetrachlorobiphenyl) with 5 of 12 detections; number 66 (2,3',4,4'-Tetrachlorobiphenyl) with 2 of 12 detections; number 105 (2,3,3',4,4'-Pentachlorobiphenyl) with 5 of 12 detections; number 118 (2,3',4,4',5-Pentachlorobiphenyl) with 1 of 12 detections; number 153 (2,2',4,4',5,5'-Hexachlorobiphenyl) with 1 of 12 detections; number 180 (2,2',3,4,4',5,5'-Heptachlorobiphenyl) with 7 of 12 detections; number 206 (2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl) with 4 of 12 detections; and number 209 (2,2',3,3',4,4',5,5',6,6'-Decachlorobiphenyl) with 1 of 12 detections. The remaining nine targeted PCB Congeners were not detected in the samples.

Flux analysis is reported for PCB Congener number 101 only, including statistical comparison with blank test data. The flux was small compared to the blank and it was negative (i.e. uptake). The 95% confidence limit values for the computed flux were large and the statistical confidence that the flux value was different than the corresponding blank was very small (4%). PCB Congener number 101 was not detected in the bulk sediment sample. The high flux rate trend noted in the first four samples for PAHs, prior to anoxic chamber conditions, was not evident for PCB Congener number 101 and separate analysis was not undertaken. Appendix D ("BP Organics Demo-PCBs.xls") includes a time-series graph showing flux and blank tests concentrations over time for PCB Congener number 101.

Flux analysis for the remaining PCBs having partial data sets was abandoned due to the degree of incomplete data and/or large intervals between data. Also, none of the PCB congeners with detections in seawater were reported in the bulk sediment analysis results.

5.1.6.1.3 Pesticides

Partial data sets were obtained for six pesticides: 2,4'-DDT with 1 of 12 detections; 4,4'-DDT with 3 of 12 detections; 4,4'-DDD with 4 of 12 detections; Dieldrin with 1 of 12 detections; Endrin with 7 of 12 detections; Mirex with 10 of 12 detections. The remaining ten targeted pesticides were not detected in the samples.

Flux analysis was accomplished for the pesticide Mirex only. No blank test results were available for this pesticide and therefore statistical comparison cannot be made. The computed flux value for Mirex was small with large 95% confidence limit values. Mirex was also not detected in the bulk sediment sample. The high flux rate trend noted in the first four samples for PAHs, prior to anoxic chamber conditions, was not evident for Mirex and separate analysis was not undertaken. Appendix A, Excel spreadsheets(.xls"), includes a time-series graph showing flux and blank tests concentrations over time for the pesticide Mirex.

Flux analysis for the remaining pesticides having partial data sets was not accomplished due to the degree of incomplete data and/or large intervals between data. And again, none were reported in the bulk sediment analysis results.

5.1.6.2 Discussion of Bishop Point Organics Results

Prior to data reduction and analysis, close inspection of the analytical laboratory results indicated a change or "knee" in sample concentration trends occurring after sample four for most PAHs, coincident with the dissolved oxygen level falling below control limits. The same change was not evident for the PCBs or pesticides, however the preponderance of "non detect" concentration levels in the seawater samples coincident with like results in the bulk sediment sample resulted in sufficient seawater data for only one PCB congener and one pesticide flux analysis. The PAHs on the other hand exhibited very large concentrations in the bulk sediment sample and 13 of sixteen yielded sufficient data for flux analysis. After correction for dilution and normalization for comparison to the blank tests the shift in concentration trends became even more evident for the PAHs and remained obscured by low concentration levels for the PCBs and pesticides. Thus separating the data sets into pre- and post-anoxic conditions for analysis allowed the affect of the low oxygen conditions on the PAH flux rates to be isolated to the last eight samples. The mechanism for this observed damping or stopping of the release of PAHs from the sediment is not known but may be related to reduction-oxidation chemistry changes causing soluble metals to precipitate and bind with organic compounds releasing from the sediment. Another possible explanation for the observed flux change may be loss of the irrigation component of the flux due to oxygen deprivation of the infaunal micro-organisms. Whatever the mechanism, it is clear that the large PAH concentrations in the sediment are the source of large flux levels entering the water column, albeit evidenced by only the first four samples. It is also clear that maintenance of at least a minimum level of dissolved oxygen (approximately 1.0 ml/L) in the chamber is required to achieve complete flux results for the full duration of the test. As a result of using compressed air in place of pure oxygen for maintenance of the chamber dissolved oxygen conditions, only the four samples collected during the first 14 hours of the test are considered valid for analysis. Of these four, only the last three were collected from the chamber at time intervals of 7 hours and thus the full value of the 12-sample, 70-hour test was not achieved. However, minimum statistical standards are met with the four samples and the following discussion and conclusions derived from them are considered valid.

As found in the Paleta Creek demonstration, the flux results for the lighter molecular weight PAHs indicate greater mobility from the sediment into the overlying water than the heavier compounds. Of interest is the measured concentration of the PAHs in the bulk sediment sample being higher for the mid-molecular weight compounds than for the lighter or the heavier compounds. This distribution of sediment concentrations resulting from the industrial and operational activity at the site, led to high flux levels for even the less soluble heavier molecular weight PAHs compared to the lighter molecular weight PAHs. Notwithstanding this result, it appears that the heavier molecular weight PAHs are significantly less mobile, even with higher concentrations in the bulk sediment, than the lighter compounds. For example, the flux value for Acenaphthene (molecular weight-154) was about the same as Fluoranthene (molecular weight-202), but the bulk sediment concentration is about 1.4% that of Fluoranthene. And, as before, comparison of this finding with solubility measurements of the targeted PAHs in seawater shows the same trend: the heavier molecular weight PAHs are far less soluble. In the example above, Acenaphthene is approximately 16.6 times more soluble than Fluoranthene. Thus even a low mobility, heavier molecular weight PAH with a high enough concentration in the sediment may flux into the overlying water at a higher rate than a lighter compound at lower concentrations.

Based on molecular weight and solubility, the above discussion also generally applies to PCBs and pesticides, i.e. their mobility as indicated by the flux results will be generally in direct proportion to solubility and in inverse proportion to molecular weight. This premise cannot be supported by the results of this demonstration due to the very low concentration levels of the PCBs and pesticides in the sediment. The one PCB and one pesticide detected with sufficient data to allow analysis yielded results with low confidence and no conclusions can be drawn from either the full set of data or the first four samples. It does appear however that both PCBs and pesticides are not a water quality issue for this site.

5.1.6.3 Conclusions for Bishop Point Organics Demonstration Test

The BFSD2 demonstration at Bishop Point, Pearl Harbor was a qualified success. A single factor, use of compressed air in place of pure oxygen for chamber dissolved oxygen maintenance, was responsible for loss of valid data after approximately 14 hours into the 72-hour test. The affect of anoxic level conditions to stop, reduce or interfere with the release of organic compounds from contaminated sediment, previously not anticipated, was established. And, prior to this affect occurring, valid data was obtained.

The results from the first 14 hours of the 72-hour test show that measurement of the mobility of organic compounds from the highly contaminated sediments at the Bishop Point site within the Pearl Harbor Naval Complex was successfully achieved. The measurements, when compared to triplicate blank test results resulted in quantification of large, statistically significant values with high confidence for Polynuclear Aromatic Hydrocarbons (PAHs) fluxing into overlying water. Complete data sets for nearly all of the targeted US EPA priority PAHs were achieved and the flux results are consistent with bulk sediment concentrations, modified by the relative solubility of the compounds. Polychlorinated Biphenyl (PCB) Congeners and pesticides were not measured either because they were not present or because they were below analytical detection limits.

Ideally, a repeat of this test should be conducted to resolve potential questions regarding oxygen control during the measurement of organic contaminant fluxes. It could be conducted at the Bishop Point site or any other site where high levels of targeted organic compounds are present in the sediment. Whereas the first demonstration at Paleta Creek established the capability of the BFSD2 and the related data analysis process to extract meaningful results at a site with moderate levels of contaminants in the sediments, this demonstration only partially established the BFSD2 performance at a site with high levels of organic contaminants in the sediment. A full 72-hour test at such a site would help to demonstrate and establish BFSD2 performance as concentration levels become very large in a high flux level condition. However, even in lieu of this additional testing, it is clear that the BFSD2 can statistically resolve fluxes for a number of organic contaminants even when the number of samples is limited.

5.1.7 Pearl Harbor, Bishop Point, Combined Demonstration

One 72-hour test was conducted to demonstrate the ability of the Benthic Flux Sampling Device 2 to collect samples for both metals and PAH analysis in a single deployment. The The MUDSU-1 facility at Bishop Point, Pearl Harbor, Hawaii was selected because both a metals deployment and a deployment for PAH's were made in the area. The combined demonstration was successfully conducted on December 9-12, 2002. A previous attempt was made in October of 2003, but because of a technical malfunction and issues with the electronic control unit of the BFSD2, that deployment was unsuccessful.

The combined demo followed the metals demonstration by 3 years and 10 months and the PAH demonstration by 1 year and 3 months. Although all the deployments were made along the quay wall at the MUDSU-1 facility, deployment logistics made it impossible to sample the exact spot in all three deployments. Hence, the combined demo position was 20 meters west of the metals deployment and 34 meters east of the PAH deployment (Figure 69). These distances should not be significant in comparing overall operation of the BFSD between deployments at a general site, but some patchy contamination of sediments may be exhibited in the results with some contaminants. Also, the difference in time between deployments could conceivably show some variability in results.

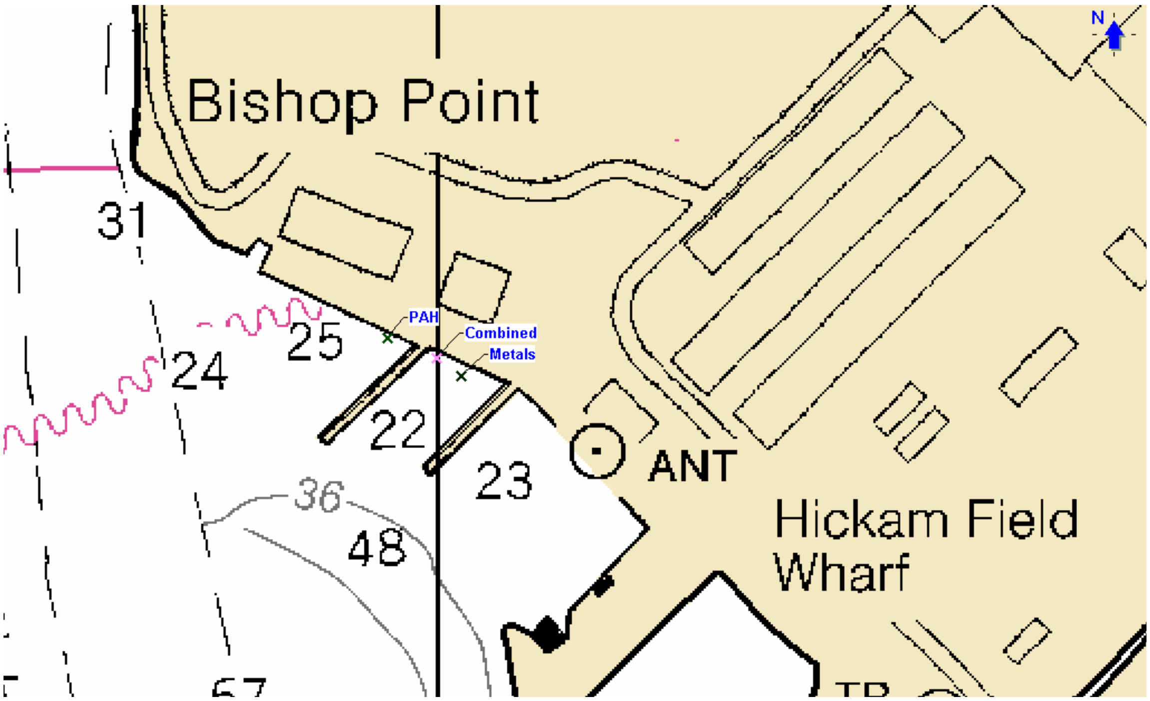
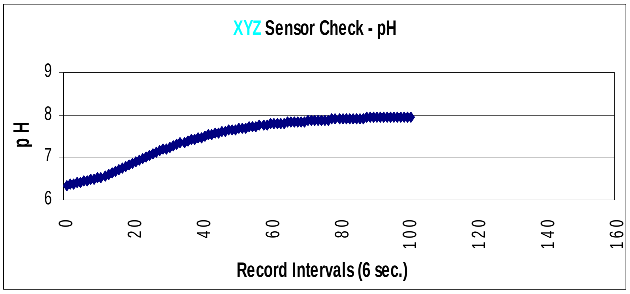


Figure 69. Pearl Harbor, Bishop Point Demonstration Locations.

The preparation and deployment for the combined demo followed very closely the procedures and events of the previous PAH demonstration deployment. The BFSD2 was cleaned, packed and shipped from SSC San Diego. When unpacked at Pearl Harbor, all systems were assembled, inspected and checked. The oxygen bottle was filled with O_2, and no problem with oxygen limitations was anticipated or encountered during the deployment as it was with the PAH deployment.

The BFSD2 was lowered into the water with a crane along the quay wall, and a pre- deployment checklist was followed. After the bottom was scanned with the onboard video camera and determined to be appropriate, the BFSD2 was landed and pre-deployment measurements taken. After the 10-minute pretest, sensors had stabilized and an oxygen range to be maintained could then be programmed for the 72-hour test from values taken during the pretest (Fig. 70). The 72-hour test was then started. Cables leading from the BFSD were disconnected from power, computers and video monitors and, together with a recovery line, were coiled and stored along the quay wall.



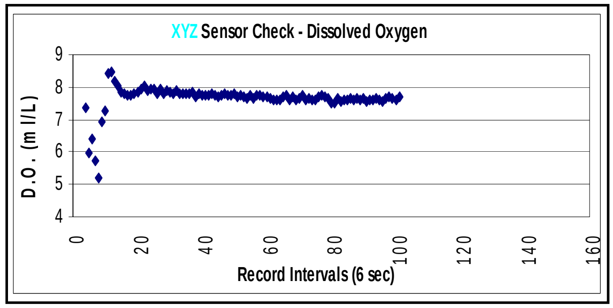
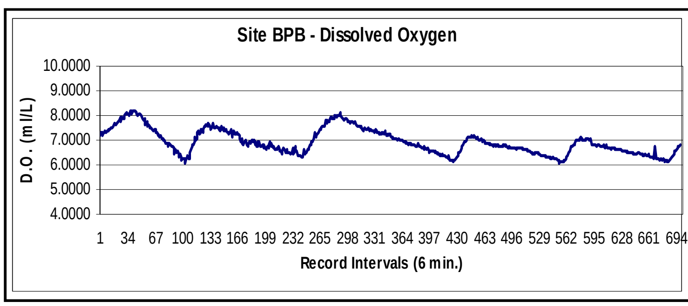


Figure 70. Pearl Harbor, Bishop Point Combined Metals Pre-Deployment Sensor Graphs.

Occasionally during the test, the cables were reconnected to the computer and video monitor and status was determined. All appeared normal during these checks and the cables resecured.

After 72 hours, the test was halted. Before the BFSD2 was raised from the bottom, data were uploaded via the stored cables on the quay wall. The BFSD2 was then raised from the bottom with the crane and deposited on the pier. The 24 sample bottles were briefly checked and found to be all full. They were then washed down, disconnected and removed from their racks. Samples were then taken to the field lab where filters were removed, labels added and they were shipped to Battelle labs for analysis.

Logged data were entered into Excel spreadsheets templates for processing. Oxygen and pH data show the deployment was successful in maintaining a tight seal and maintenance of the flux chamber integrity. Figure 71 shows a steady decline in pH which indicates no loss of seal or sudden contamination from outside the chamber. Figure 71 also shows the chamber was maintained oxic with the assistance of the O_2 feedback and injection system.



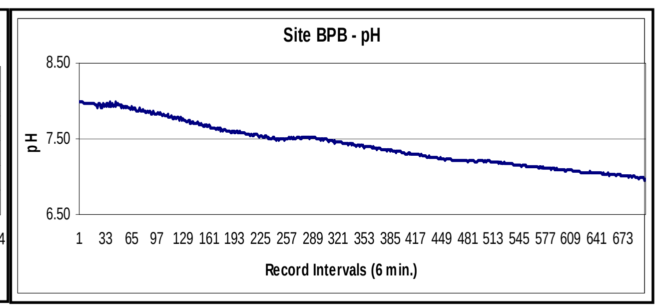


Figure 71. Pearl Harbor, Bishop Point Combined Metals Full Test Sensor Graphs.

5.1.7.1 Pearl Harbor Combined Demonstration Results

Table 18 gives a summary of the flux results for metals and Figure 72 show these in graphical form. Flux of dissolved oxygen from the chamber, or the oxygen demand of the sediments, is also given in Table 18. This was calculated from the O_2 data logged from the chamber during the first decreasing slope in the 72-hour test before the O_2 feedback injection system raised the O_2 level.

Metals behaved similarly in this combined demonstration as they did in the original metals demonstration at the Bishop Point Site except for copper (Figure 73). Cadmium, lead, nickel, manganese and zinc all fluxed out of the sediments, a trend which is consistent with previous work,

while copper was adsorbed by the sediment. Copper fluxed out of the sediments during the initial study. Manganese behaved similarly in both studies in that it exhibited a higher flux rate during the first three samples of the test then leveled off for the remainder of the test period. This trend with Manganese is discussed in the Paleta Creek discussion section 5.1.3.1. Flux rates for manganese for the first 14 hours of the test as well as for the entire test are presented here. In general, flux rates were higher during this combined demonstration than during the metals-only demonstration.

PAH flux results are presented in two ways. First, the entire 72-hour test results with all twelve samples are presented. These data are presented in Figures 74 and 75 and Table 19. Then, secondly, results from the first four samples of the test, those up to 21.3 hours into the test, are shown. This is for comparison to the original organics-only demonstration where flux rates showed an initial slope then plateaued. In the original test, oxygen depletion in the chamber was theorized as the cause for this plateau, but oxygen levels were successfully maintained in the chamber during the second test. For whatever reasons this plateauing occurs, the trend seemed to repeat itself during the combined demonstration. For comparison purposes, the "first four" data are used to calculate flux rates.

Table 18. Pearl Harbor, Bishop Point Combined Metals Summary of Metals.

Metal	Flux	+/- 95% C.L.	Flux rate Confidence	Triplicate Blank Flux (□g/m^2/day)	
	(□g/m^2/day)*	(□g/m^2/day)	(%)	Average	+/- 95% C.L.
Arsenic (As)	23.48	6.94	100%	-5.16	2.10
Copper (Cu)	-71.30	39.43	100.0%	2.82	8.73
Cadmium (Cd)	1.31	1.63	98.1%	-0.52	0.75
Lead (Pb)	17.40	24.63	99.0%	3.16	1.59
Nickel (Ni)	59.18	55.96	100.0%	10.28	7.34
Manganese (Mn)	427.65	238.42	100.0%	-264.85	7.49
Manganese (Mn)[1]	1940.13	3853.39	100.0%	-264.85	7.49
Silver (Ag)	-0.36	0.88	86.1%	0.64	0.68
Zinc (Zn)	374.36	133.74	100.0%	-3.38	65.22
Other					
Oxygen (O_2)* (*ml/m^2/day)	-1457.09	48.92	na	na	na
Silica (SiO_2)* (*mg/m^2/day)	0.00	0.00	48%	-1.97	2.88

1. Mn flux calculated on the first three samples due to non-linearity and to compare with metals-only demonstration

Flux rates for PAH's were similar in this combined test as it was in the original test. All PAH's that were measured fluxed out of the sediments except for phenanthrene. The largest flux rate measurement was for fluoranthene which also showed a large presence in the original test. This was followed by anthracene, acenaphthene and naphthalene, again similar to the original test. Similarities from the first test were also seen in the heavier molecular weight PAH's as benzo(a)pyrene,

benzo(k)flouranthene and chrysene showed large presence. Benzo(a)pyrene also showed a spike in this test but wasn't detected in the original test.

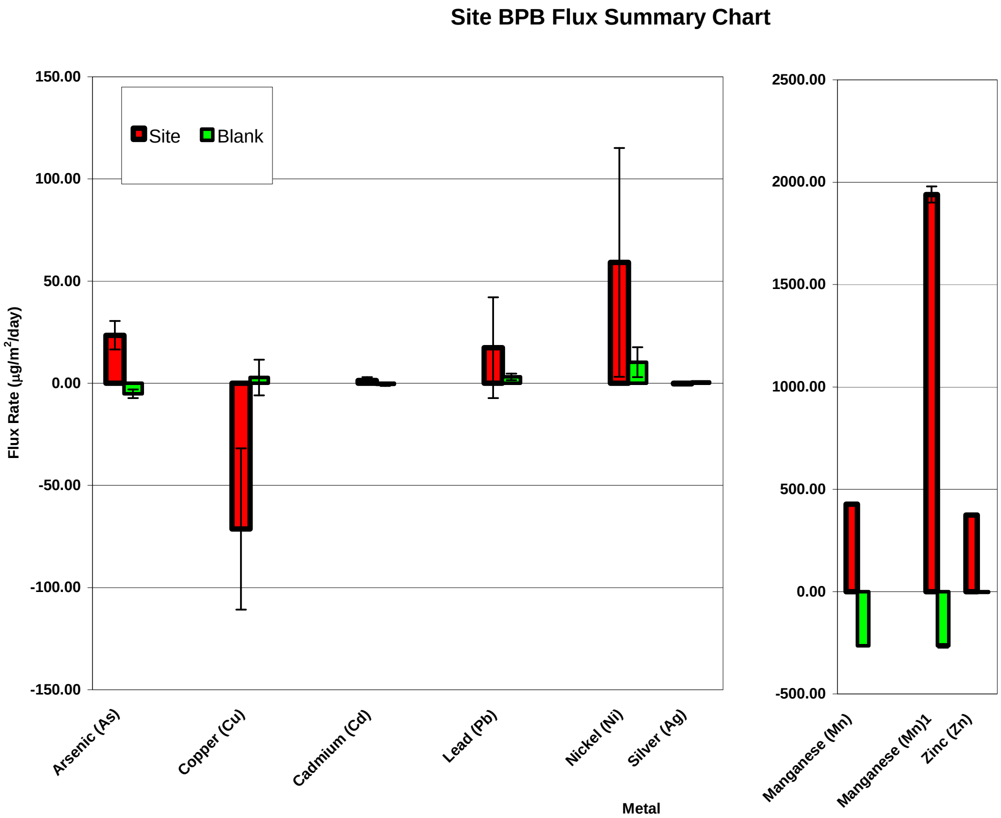


Figure 72. Pearl Harbor, Bishop Point Combined Metals Comparison of Flux and Blanks.

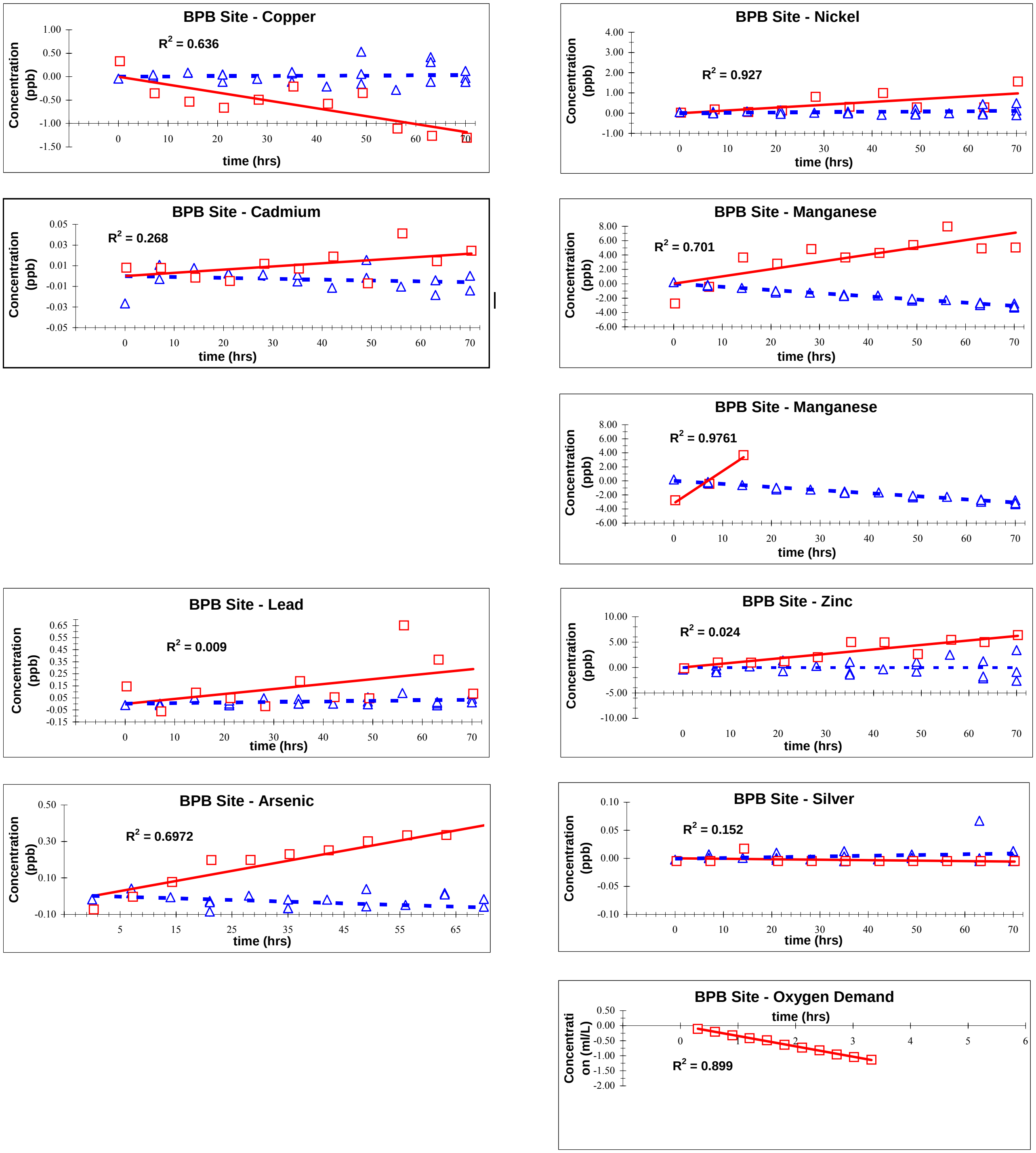
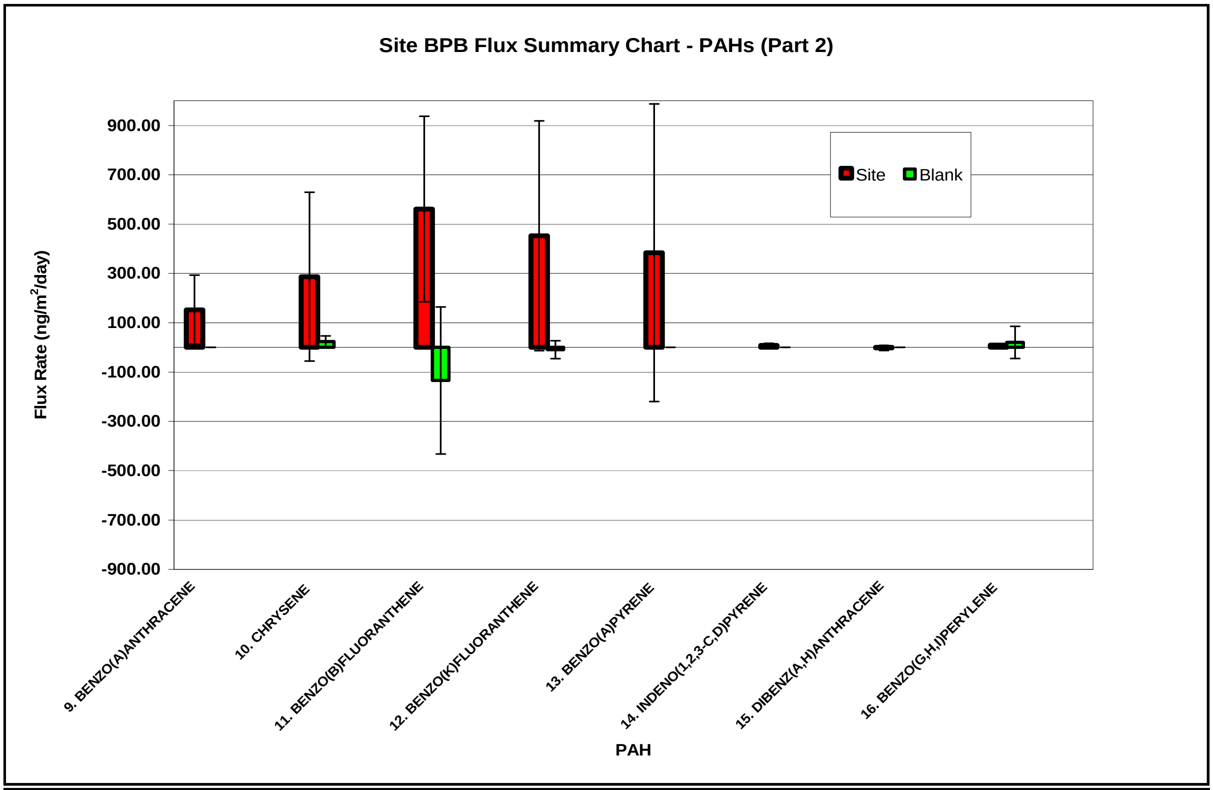


Figure 73. Pearl Harbor Bishop Point Combined Demonstration Metals Time Series Graphs.

Table 19. Pearl Harbor, Bishop Point Combined Demo Summary Results for PAH's (all samples**).**

PAH	Flux (ng/m^2/day)*	+/- 95% C.L. (ng/m^2/day)	Flux Rate Confidence (%)	Triplicate Blank Flux (ng/m^2/day) Average	+/- 95% C.L.
1. Naphthalene	711.03	2352.17	92.8%	-440.30	458.38
2. Acenaphthene	-1387.81	1989.31	91.4%	-32.40	50.34
3. Acenaphthylene	106.66	213.64	31.9%	208.47	112.60
4. Fluorene	-359.38	256.56	100.0%	-76.74	28.38
5. Phenanthrene	-639.76	1228.00	99.6%	10.95	10.95
6. Anthracene	763.68	546.29	100.0%	117.68	64.62
7. Fluoranthene	2749.93	3651.35	100.0%	-1423.95	178.41
8. Pyrene	2191.62	2392.29	100.0%	-439.51	70.73
PAH	**Flux (ng/m^2/day)***	**+/- 95% C.L. (ng/m^2/day)**	**Flux rate Confidence (%)**	**Triplicate Blank Flux (ng/m^2/day) Average**	**+/- 95% C.L.**
9. BENZO(A)ANTHRACENE	152.67	140.49	NA	NA	NA
10. CHRYSENE	286.65	341.92	94.7%	23.94	22.32
11. BENZO(B)FLUORANTHENE	561.07	376.08	97.9%	-134.30	297.91
12. BENZO(K)FLUORANTHENE	452.24	465.75	82.8%	-9.71	36.30
13. BENZO(A)PYRENE	383.46	603.38	NA	NA	NA
14. INDENO(1,2,3-C,D)PYRENE	8.68	10.98	NA	NA	NA
15. DIBENZ(A,H)ANTHRACENE	-1.97	7.69	NA	NA	NA
16. BENZO(G,H,I)PERYLENE	8.77	10.59	12.9%	20.15	65.15



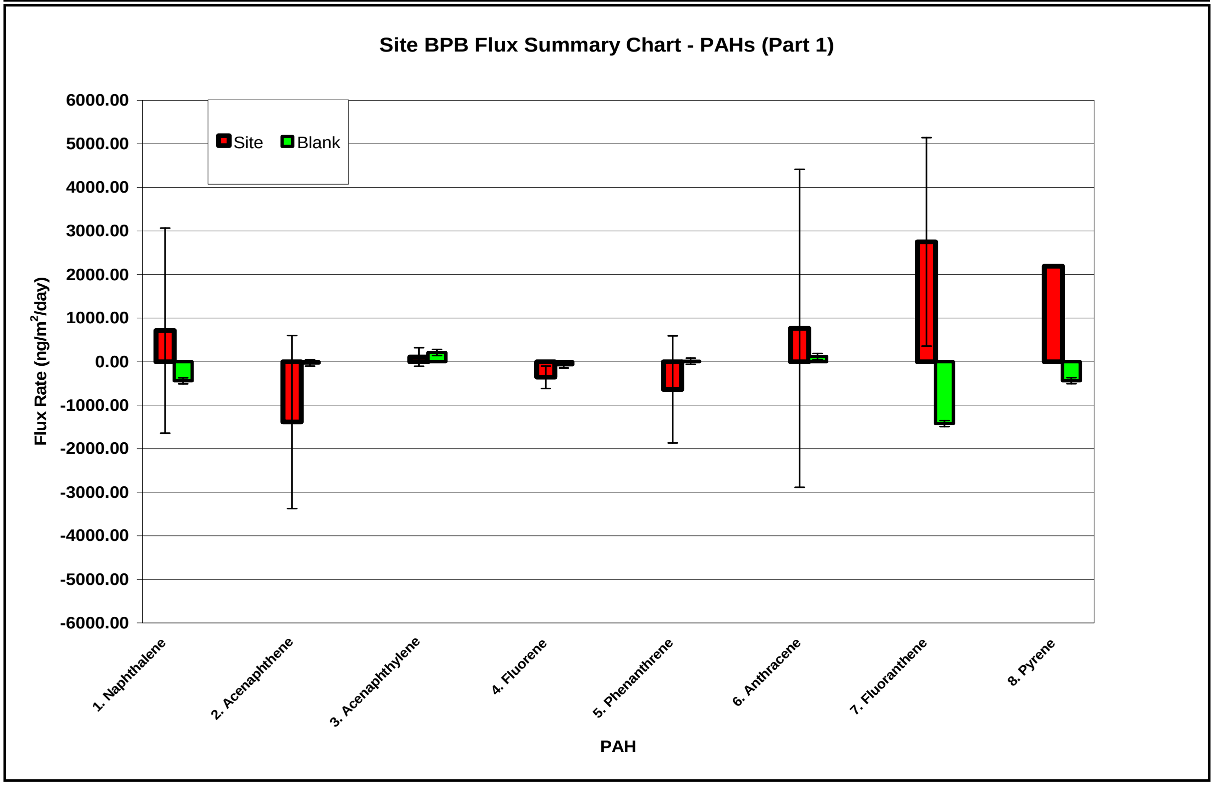


Figure 74. Pearl Harbor, Bishop Point Combined PAH Comparison of Flux to Blanks (all samples**).**

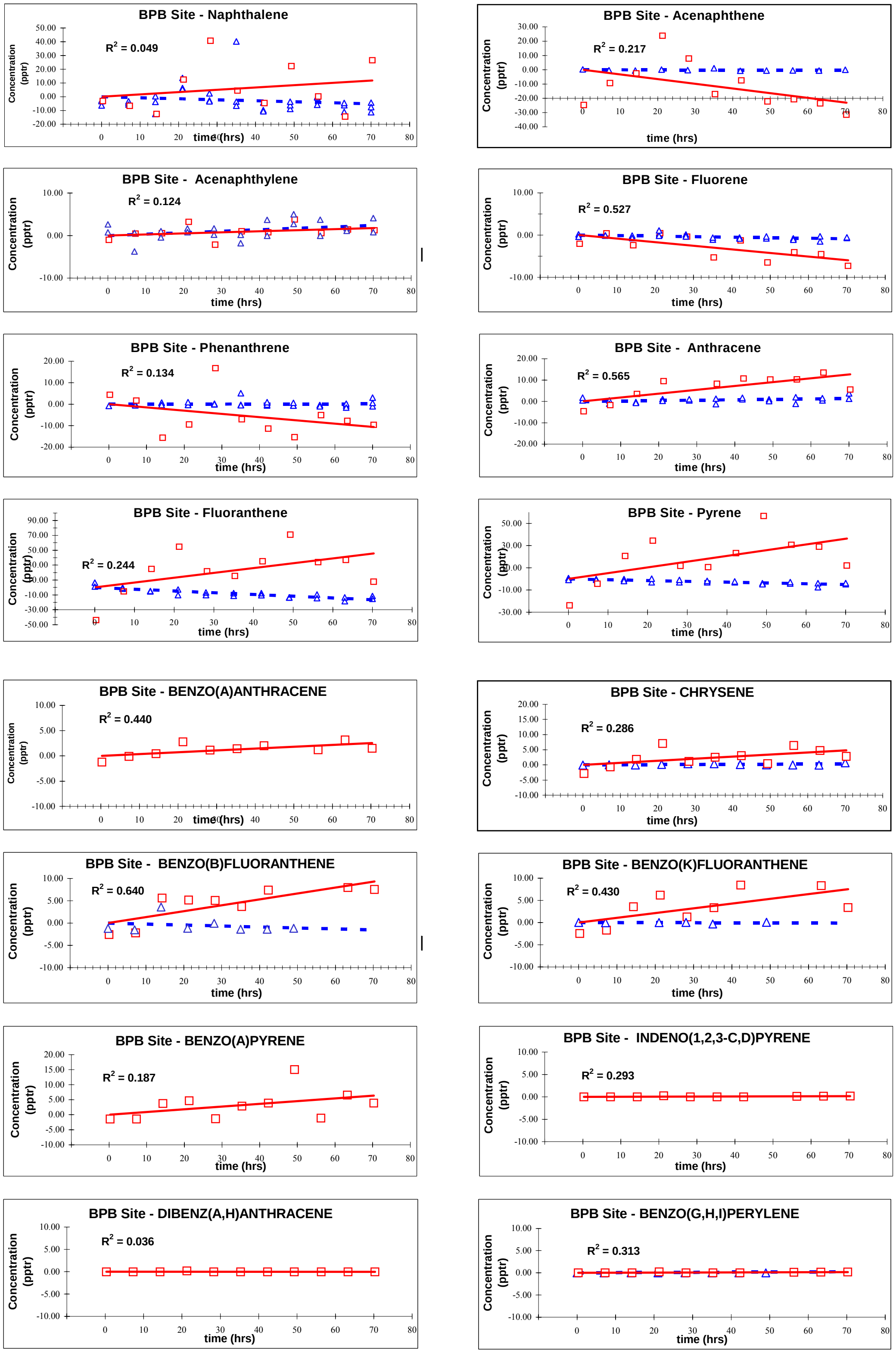
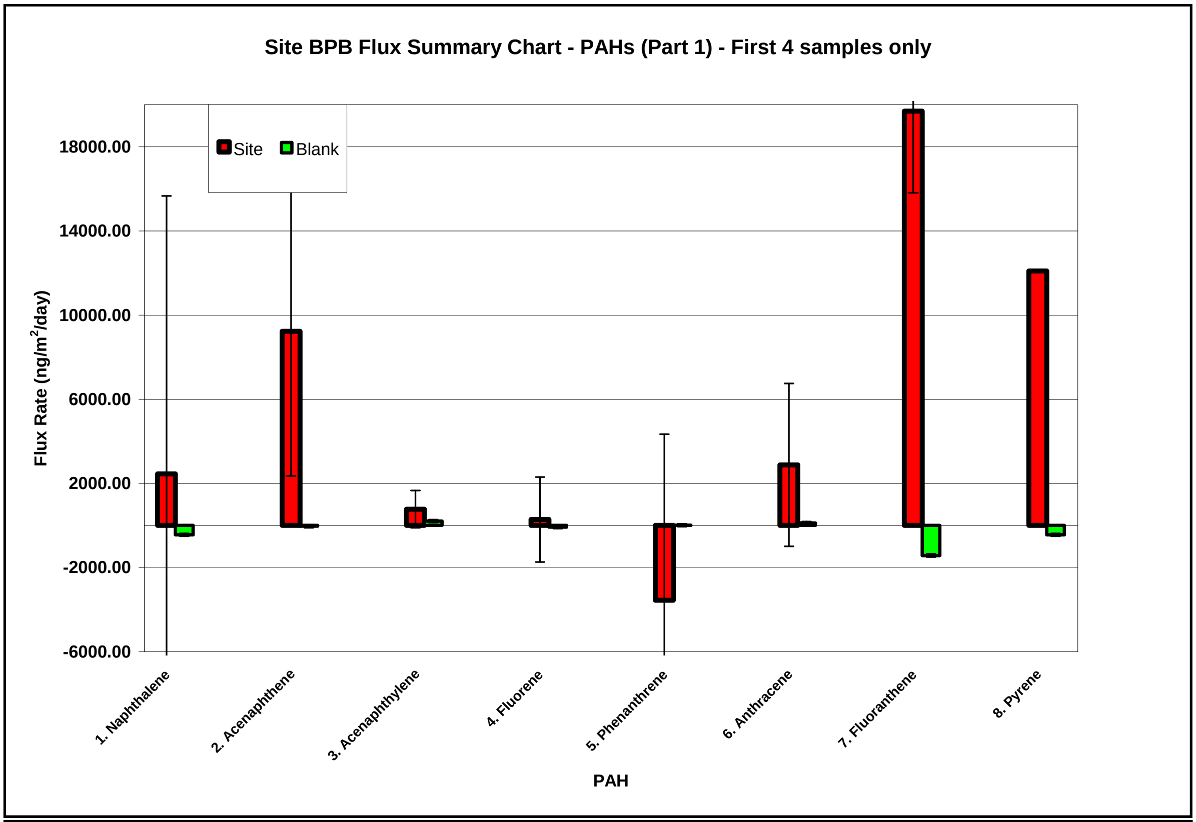


Figure 75. Pearl Harbor, Bishop Point Combined Demonstration PAH Time Series Graphs (all samples**).**

Table 20. Pearl Harbor, Bishop Point Combined Demo Summary Results for PAH's (First 4 samples**).**

PAH	Flux (ng/m2/day)*	+/- 95% C.L. (ng/m2/day)	Flux Rate Confidence (%)	Triplicate Blank Flux (ng/m2/day) Average	Triplicate Blank Flux (ng/m2/day) +/- 95% C.L.
1. Naphthalene	2456.72	13211.63	100.0%	-440.30	458.38
2. Acenaphthene	9222.27	6867.34	100.0%	-32.40	50.34
3. Acenaphthylene	778.37	880.29	100.0%	208.47	112.60
4. Fluorene	285.70	2021.66	100.0%	-76.74	28.38
5. Phenanthrene	-3555.98	7892.27	100.0%	10.95	10.95
6. Anthracene	2874.10	1330.22	100.0%	117.68	64.62
7. Fluoranthene	19696.65	3869.67	100.0%	-1423.95	178.41
8. Pyrene	12101.21	3884.64	100.0%	-439.51	70.73
PAH	**Flux (ng/m2/day)***	**+/- 95% C.L. (ng/m2/day)**	**Flux rate Confidence (%)**	**Triplicate Blank Flux (ng/m2/day) Average**	**Triplicate Blank Flux (ng/m2/day) +/- 95% C.L.**
9. BENZO(A)ANTHRACI	760.90	668.14	NA	NA	NA
10. CHRYSENE	1949.20	1370.02	100.0%	23.94	22.32
11. BENZO(B)FLUORAN	1878.90	2921.78	100.0%	-134.30	297.91
12. BENZO(K)FLUORAN	1890.04	1526.34	100.0%	-9.71	36.30
13. BENZO(A)PYRENE	1413.41	1785.07	NA	NA	NA
14. INDENO(1,2,3-C,D)PY	41.71	103.62	NA	NA	NA
15. DIBENZ(A,H)ANTHR	34.46	85.60	NA	NA	NA
16. BENZO(G,H,I)PERYI	39.90	99.12	43.2%	20.15	65.15



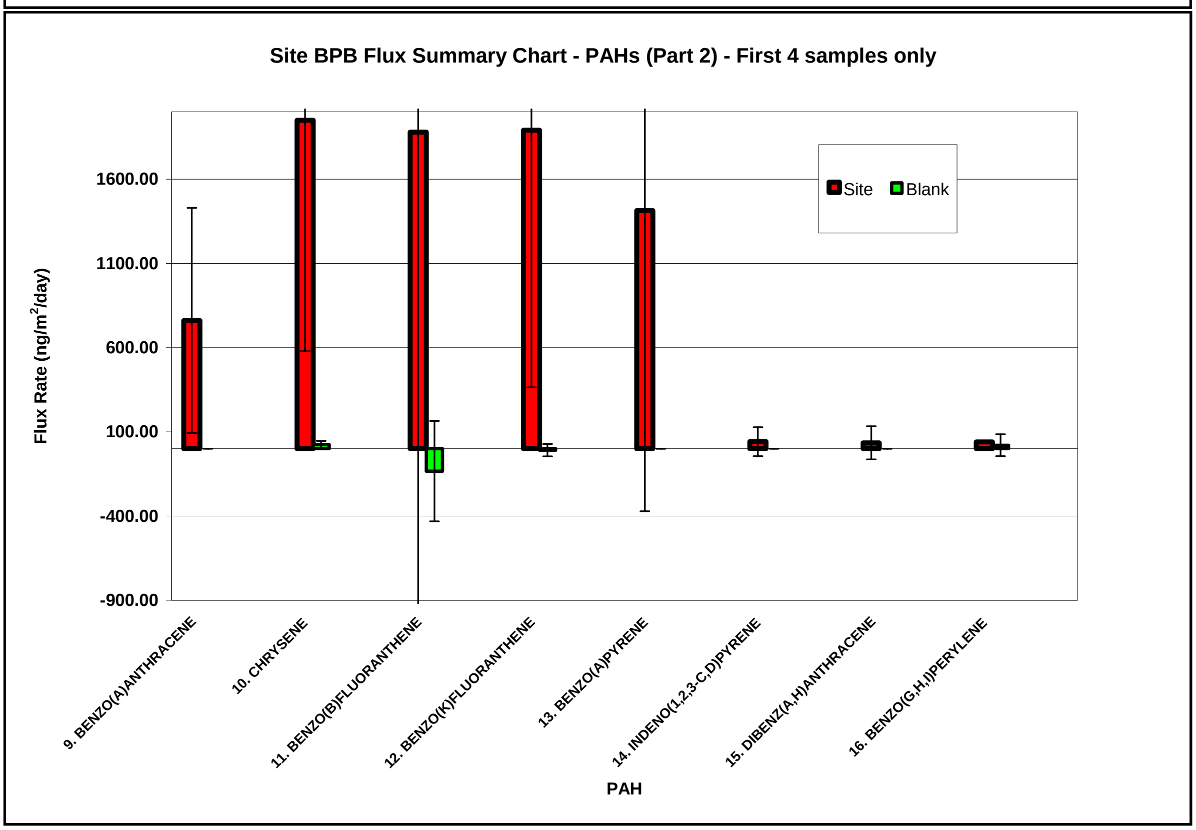


Figure 76. Pearl Harbor, Bishop Point Combined PAH Comparison of Flux to Blanks (First 4 samples**).**

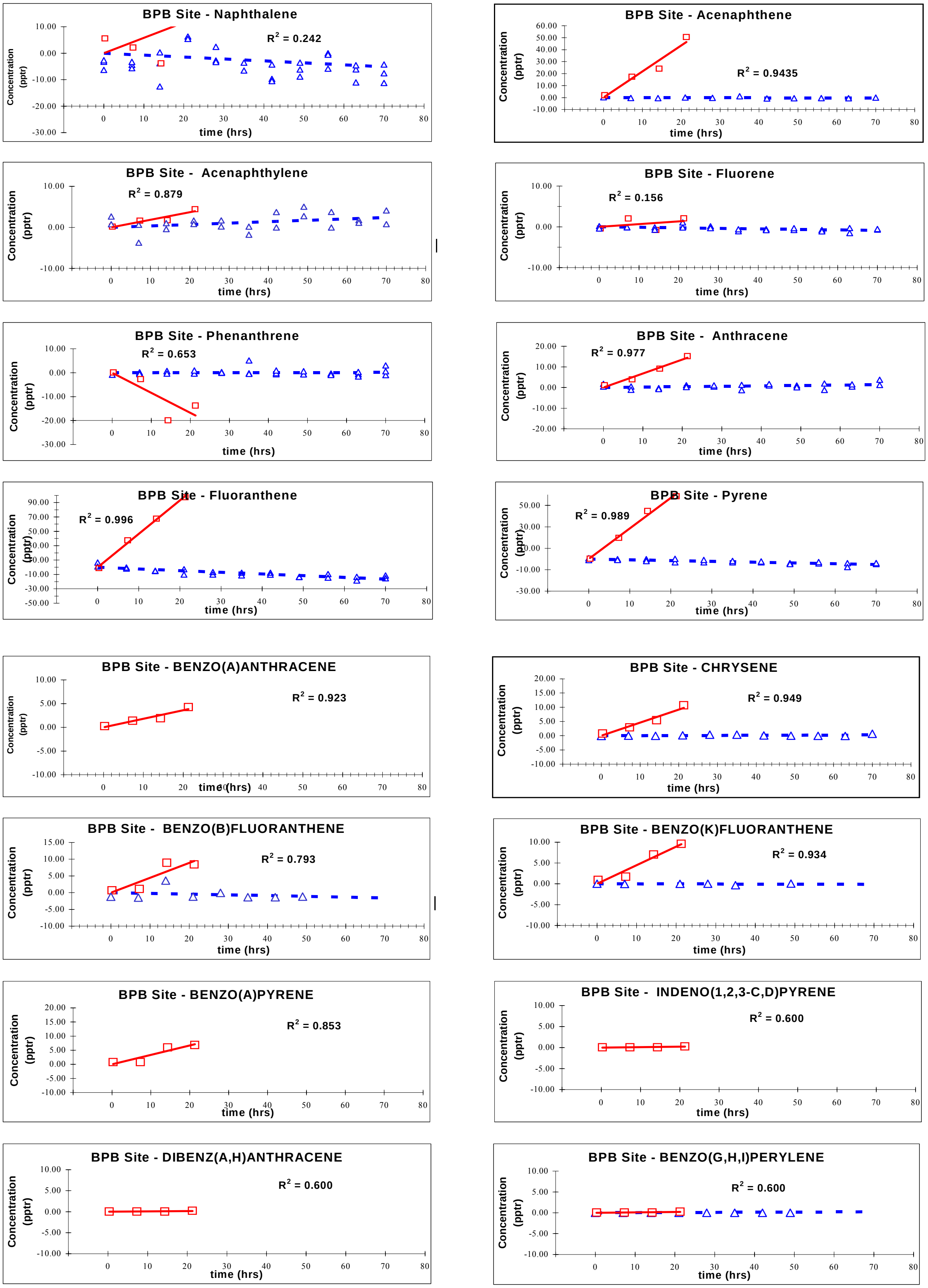


Figure 77. Pearl Harbor, Bishop Point Combined Demonstration PAH Time Series Graphs (First 4 samples**).**

5.1.7.2 Pearl Harbor Combined Demonstration Discussion

For the most part, flux rates for metals and organics behaved similarly at the Bishop Point sight for both the organics-only, metals-only and this combined demonstration of both organics and metals. Tables 21 and 22 show a side by side comparison of these demonstration flux results.

Table 21. Comparison of Flux Rates from Metals-only and Combined Demonstrations.

	Combined Demo		Metals Only Demo	
Metal	Flux (□g/m2/day)*	+/- 95% C.L. (□g/m2/day)	Flux (□g/m2/day)*	+/- 95% C.L. (□g/m2/day)
Arsenic (As)	23.48	6.94		
Copper (Cu)	-71.30	39.43	112.46	17.60
Cadmium (Cd)	1.31	1.63	1.85	1.96
Lead (Pb)	17.40	24.63	0.71	1.11
Nickel (Ni)	59.18	55.96	21.04	15.41
Manganese (Mn)	427.65	238.42	223.33	284.79
Manganese (Mn)1	1940.13	3853.39	2177.45	192.60
Silver (Ag)	-0.36	0.88		
Zinc (Zn)	374.36	133.74	191.18	54.07

Copper and zinc are the only metals which showed a significant difference between sampling during the first metals only demo and the combined demo. Copper actually showed a reverse trend during the second test. Zinc flux rate was higher during the combined demo than during the first. However, cadmium, lead, nickel and manganese showed similar trends and lay within the 95% confidence intervals of the calculated slopes. Arsenic and silver were not reported during the first test and could not be compared here.

Flux rates for PAH's were calculated for the first 4 samples taken in order to compare with the original Bishop Point organics test. Concentrations for PAH's for both tests evened out or plateaued after the fourth sample was collected at about 22 hours. The "first four" flux rates are probably more realistic as that was measured before any interference or interaction with natural, in-situ processes caused by the chamber itself. The only organic which was significantly different from the first test was Phenanthrene which showed a negative flux or and absorption into sediments during the combined demo. All other organic compounds measured during the first test showed similar flux rates when compared to the 95% confidence limits of the flux curves.

The cause for the organic concentrations leveling off is not immediately known. Low oxygen levels and anoxic conditions inside the chamber during the first test were blamed for the effect. However

adequate oxygen conditions were maintained during the second test with the same result. High bulk sediment concentrations measured at Bishop Point may suggest a loading or saturation of PAH's within the chamber after 22 hours which would result in a dampening of the flux processes.

Table 22. Comparison of Flux Rates from PAH-only and Combined Demonstration.

PAH	Combined Demo Flux (ng/m2/day)*	Combined Demo +/- 95% C.L. (ng/m2/day)	PAH Only Demo Flux (ng/m2/day)*	PAH Only Demo +/- 95% C.L. (ng/m2/day)
1. Naphthalene	2456.72	13211.63	1848.00	4406.00
2. Acenaphthene	9222.27	6867.34	71053.00	327574.00
3. Acenaphthylene	778.37	880.29	6862.00	14388.00
4. Fluorene	285.70	2021.66	10387.00	110972.00
5. Phenanthrene	-3555.98	7892.27	3031.00	106689.00
6. Anthracene	2874.10	1330.22	26955.00	27293.00
7. Fluoranthene	19696.65	3869.67	69812.00	380980.00
8. Pyrene	12101.21	3884.64	24512.00	190722.00
PAH	Flux (ng/m2/day)*	+/- 95% C.L. (ng/m2/day)	Flux (ng/m2/day)*	+/- 95% C.L. (ng/m2/day)
9. BENZO(A)ANTHRACENE	760.90	668.14	Non-Detect	NA
10. CHRYSENE	1949.20	1370.02	8792.74	10650.17
11. BENZO(B)FLUORANTHENE	1878.90	2921.78	3080.74	17862.21
12. BENZO(K)FLUORANTHENE	1890.04	1526.34	977.52	3135.53
13. BENZO(A)PYRENE	1413.41	1785.07	Non-Detect	NA
14. INDENO(1,2,3-C,D)PYRENE	41.71	103.62	122.97	7141.99
15. DIBENZ(A,H)ANTHRACENE	34.46	85.60	Non-Detect	NA
16. BENZO(G,H,I)PERYLENE	39.90	99.12	33.19	5249.47

5.1.8 Paleta Creek and Pearl Harbor Metals Demonstrations Data Assessment. BFSD2 performance assurance indicators show that: (1) a proper seal was achieved during both sets of demonstration deployments and chamber isolation of test water was maintained; (2) oxygen levels were maintained close to ambient levels, and; (3) silica, oxygen and pH trends varied as expected.

It was concluded that the two sets of deployments of BFSD2 at Paleta Creek and at Pearl Harbor, Hawaii demonstrated consistent performance and the ability to measure trace metal mobility at distinctly different sites. Ease of operation and reliability were also demonstrated. It was further concluded that BFSD2 can provide accurate and repeatable measurements of the mobility of trace metal contaminants to and from shallow water marine sediments when certain prerequisite conditions

are met. These sediment flux rates can be established with high confidence when the routine procedures, standard methods and protocols demonstrated during this study are followed. The BFSD2 and its support equipment are mobile by air transport, field portable and can be operated with a minimum of resources. Comparison of measured sediment fluxes with blank-chamber fluxes provides a statistical benchmark for the significance of the measured flux rates. Where statistically significant fluxes are observed, evaluation of impacts on water quality can be carried out, or comparisons can be made to bioaccumulation measurements to help identify exposure pathways. The resulting analysis will provide a significant new tool in evaluating potential cleanup options at contaminated sediment sites.

5.1.9 Technology Comparison

There are no directly comparable technologies to the Benthic Flux Sampling Device for *in situ* contaminated sediment flux measurements. Current alternative approaches, such as bulk sediment analysis, have been discussed throughout this report. Alternate methods and associated costs are discussed in section 6.1.4. Site specific considerations must be considered in determining which combination of technologies will provide the best information. Data analysis and interpretation is likewise dependent on site specific considerations as illustrated in this report.

6. Cost Assessment

6.1 Cost Performance

The expected operational costs for the Benthic Flux Sampling Device 2 (BFSD2) are largely driven by analytical laboratory costs. Although typical analytical laboratory prices have shown reductions, the detection level required to achieve meaningful BFSD2 flux measurements requires specialized equipment and highly skilled technicians available at limited sources. Other BFSD2 expected operational costs are driven primarily by labor, supplies and transportation costs during the pre-operational, operational and post-operational phases of deployment. The combined metals and organics demo has shown how a single deployment can collect data for both metals and organic compounds thus reducing the cost if both are desired at a single location. Lab analysis costs are increased but are offset by logistical and travel costs.

6.1.1 Pre-Operational Phase Costs

The costs incurred prior to field operations are derived from expenses involved with: site research and applicability; logistics planning and scheduling; equipment maintenance and repair; and pre-deployment readiness preparations (supplies, packing, checkout). Table 23 and Figure 78 below include expected pre-operational phase costs and an associated schedule of activities.

Table 23. Expected Pre-Operational Phase Costs for BFSD2 Deployment.

	Labor		Non-Labor		Totals
	Govt	Contr	Matls	Other	
Site Research	$5,580	$0	n/a	$1,000	**$6,580**
Logistics Plans	$7,000	$0	n/a	$0	**$7,000**
Maint and Repair	$1,600	$4,200	$500	$0	**$6,300**
Readiness Prep	$2,000	$10,850	$500	$0	**$13,350**
Totals	**$16,180**	**$15,050**	**1000**	**$1,000**	**$33,230**

No.	Activity	Cost
1	Pre-Operational Phase	$33,230
2	Site Research	$6,580
3	Historica Reports	$1,000
4	Current Reports	$1,000
5	Site Survey	$2,580
6	Analysis/Interpretation/Report	$2,000
7	Logistics Planning/Scheduling	$7,000
8	Prepare Plan	$1,000
9	Facilities/Equip/Support	$2,000
10	Access/Clearance/Permits	$2,000
11	Support Contract	$2,000
12	Equip Maint and Repair	$6,300
13	Supplies	$500
14	Readiness Preparation	$13,350
15	Test/Checkout	$10,600
16	Supplies	$1,400
17	Packing	$1,350

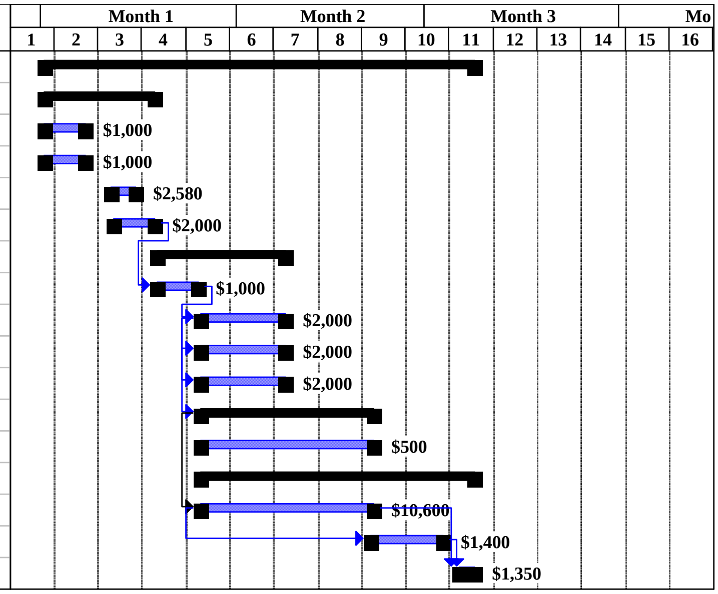


Figure 78. Expected Pre-Operational Phase Schedule for BFSD2 Deployment.

6.1.2 Operational Phase Costs

The costs incurred for field operations are derived from expenses involved with: equipment transportation; personnel travel and per diem; field facilities (shoreside work area, surface vessel, handling equipment); deployment, recovery and turnaround on a 5-day cycle; and analytical laboratory costs for one blank test and the required number of sites. Table 24 and Figure 79 below include expected operational phase costs and an associated schedule of activities.

Table 24. Expected Operational Phase Costs for BFSD2 Deployment.

	Labor		Non-Labor			Totals
	Govt	Contr	Matls	Lab	Other	
Equip Trans	$100	$200	$0	n/a	$1,000	**$1,300**
Travel	$800	$600	$0	n/a	$1,240	**$2,640**
Equip/Facilities	$1,600	$1,200	$0	$0	$0	**$2,800**
Blank Test	$4,000	$3,000	$0	$12,000	$1,200	**$20,200**
Site #1	$4,000	$3,000	$0	$12,000	$2,700	**$21,700**
Site #2	$4,000	$3,000	$0	$12,000	$2,700	**$21,700**
Totals	**$14,500**	**$11,000**	**$0**	**$36,000**	**$8,840**	**$70,340**

No.	Activity	Cost
18	Operational Phase	$70,340
19	Equipment Transportation	$1,300
20	Personnel Travel	$2,640
21	Equipment/Facilities setup/checkout	$2,800
22	Blank Test	$20,200
23	Blank Test	$8,200
24	Lab Anaysis	$12,000
25	Site #1	$21,700
26	Decon/Deploy/Recover	$9,700
27	Lab Analysis	$12,000
28	Site #2	$21,700
29	Decon/Deploy/Recover	$9,700
30	Lab Analysis	$12,000

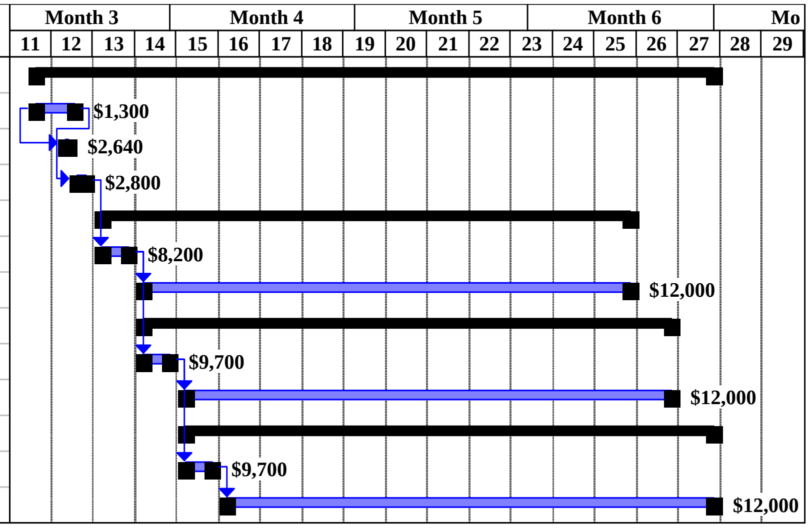


Figure 79. Expected Operational Phase Schedule for BFSD2 Deployment.

The operational phase costs for one site, which includes the costs for transportation, setup and a blank test are $48,640, of which 49% is for analysis of the samples. Each additional site adds $21,700 to the total, of which 55% is for analysis of the samples. The operational phase schedule is likewise strongly driven by the standard 60-day laboratory analysis time, which can be shortened to 30-days or less, at additional cost. The 5-day operations period for a BFSD2 72-hour deployment, recovery and turnaround cycle fits conveniently with a standard workweek schedule. An accelerated schedule which shortens turnaround time and includes weekend work periods can achieve two deployments per week.

6.1.3 Post-Operational Phase Costs

The costs incurred following completion of site operations are derived from expenses involved with: equipment packing and transportation; personnel travel; data processing, analysis and interpretation; report preparation. Table 25 and Figure 80 below include expected post-operational phase costs and an associated schedule of activities.

Table 25. Expected Post-Operational Phase Costs for BFSD2 Deployment.

	Labor		Non-Labor			Totals
	Govt	Contr	Matls	Lab	Other	
Equip Pkg/Trans	$0	$1,500	$0	n/a	$1,000	**$2,500**
Travel	$800	$600	$0	n/a	$1,240	**$2,640**
Data Review	$20,000	$13,000	$0	$0	$0	**$33,000**
Report Prep	$24,000	$0	$0	n/a	$0	**$24,000**
Totals	**$44,800**	**$15,100**	**$0**	**$0**	**$2,240**	**$62,140**

No.	Activity	Cost
31	**Post-Operational Phase**	**$62,260**
32	**Equipment Packing/Transportation**	**$2,500**
33	**Personnel Travel**	**$2,640**
34	**Data Processing, Analysis, Interpretat**	**$33,120**
35	**Report Preparation**	**$24,000**

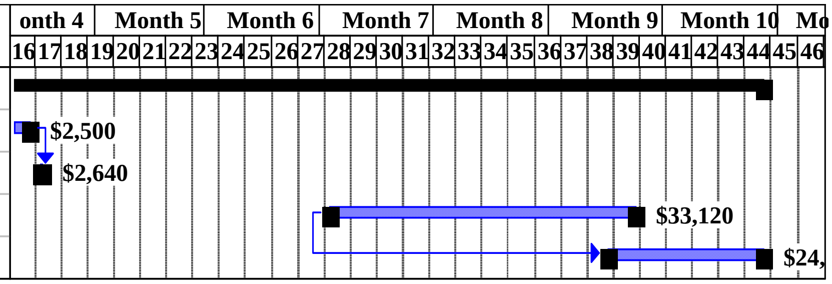


Figure 80. Expected Post-Operational Phases Schedule for BFSD2 Deployment.

The post-operational phase costs are largely the labor costs to process, analyze, interpret and report the results of the BFSD2 deployments. The costs are approximately the same regardless of the number of deployments as long as the sites have generally common geophysical and geochemical characteristics. The schedule is driven by the inactive period of time while awaiting results from laboratory analysis of the samples.

6.1.4 Alternative Methods

As discussed extensively in key reference 3, alternative sample collection methods to BFSD2's *in situ* collection and filtering of samples from the sediment-water diffusive interface are available. As with BFSD2, samples collected with alternative methods will require equivalent specialized laboratory analyses in order to determine contaminant flux rates. Those costs would be equivalent. Thus a direct comparison focusing on the method of sample collection is useful. Available alternate methods fall into two approaches, *ex situ* and *in situ*. Either of the approaches introduce error sources not present with BFSD2 and minimizing the affects of the error sources increases costs and complexity. Sample integrity becomes a significant factor. These issues aside, *ex situ* approaches can be as much as 50% cheaper for the field work, but this advantage quickly disappears with sediment processing costs. Alternative *In Situ* approaches, where applicable, may yield even greater savings than 50% for the field work, but careful consideration of the factors discussed below may discourage their use.

Both alternative approaches involve isolation of sediment pore water. With either approach, the primary source of error is the oxidation of anoxic pore water, which can significantly alter the aqueous phase trace metals. To prevent oxidation, samples must be processed and handled in an inert atmosphere, typically nitrogen or argon. *Ex Situ* methods typically first collect sediment samples which then require additional processing to extract pore water – requiring an inert atmosphere. Centrifuging or squeezing the sediment are accepted practices, but they too introduce error sources including solid-solution interactions. Sectioning samples prior to extraction to resolve sample depth for gradient determinations also adds cost and introduces errors. In addition, *Ex Situ* samplers must be rugged enough for field use yet provide isolation of the sediment sample from metal components. This is particularly difficult for dredging and grab sampling equipment however coring equipment can include non-metallic sleeves. Alternative *in situ* methods collect pore water samples at the sediment interface using either suction filtration techniques or dialysis. *In Situ* filtration techniques are limited to coarse grain sediments and do not offer depth resolution. Dialysis techniques incur minimum error sources, but suffer sample collection times as long as 20 days and produce small sample volumes. Periodic sample collection comparable to BFSD2 could require months, which in turn raises a number of additional issues.

7. Regulatory Issues

7.1 Approach to Regulatory Compliance and Acceptance

Regulatory acceptance has been a fundamental part of this project from the start and was included in the initial execution plan. The approach included application to the California Environmental Protection Agency (CA EPA), Department of Toxic Substances Control (DTSC) program known as "Cal Cert". A formal "Services Agreement" was signed with the State of California and funded for technology evaluation and certification services. In addition, CA EPA membership in the Interstate Technology and Regulatory Cooperation (ITRC) group of the Western Governors Association (WGA) and the resulting multi-state recognition of certified technologies by at least the 26 member states' environmental protection agencies promotes recognition and acceptance the BFSD2. Recognition and acceptance by the U.S. Environmental Protection Agency (US EPA), as well as private sector, Native American and foreign interests, is also promoted by their active participation in the ITRC. And, US EPA, state, local and private environmental professionals, as well as CA EPA evaluators were in attendance at field demonstrations, which included technology briefings and displays. Finally, certification by CA EPA includes public notifications and listings officially distributed to a wide range of recipients.

The Cal Cert application involved CA EPA review of the technology including background publications, reports, test and evaluation data, and a SSC SD site visit for technical discussions and equipment inspection. Due to the unique nature of the BFSD2 technology, a DTSC-wide search for a qualified lead technology evaluator was necessary to locate and secure the services needed for this project. Following acceptance of the Cal Cert application a performance claim was made by SSC SD After initial certification for metals, the CA Cert formal Services Agreement was amended to include organics applications. Additional funds to support their organics evaluation were provided also as amendments to previous documents.

The demonstrations performed for this project were key elements in the Cal Cert process. CA EPA evaluators reviewed the site selections, the test plans and attended the field demonstrations. Independent measurements, data review and analyses were accomplished by the CA EPA evaluators. Appendix F is the formal Cal Cert certificate and publicly released report. The Final Technology Evaluation report is listed in References, Section 10.

8. Technology Implementation

8.1 DoD Need

Sediments in many US bays and harbors are contaminated with potentially harmful metal and organic compounds. Contamination occurred directly through disposal of shipyard and shipboard waste, and indirectly through urban runoff and groundwater exchange with land sites. Federal, state and local regulatory agencies are in the process of adopting strict sediment quality criteria. These regulations represent a significant compliance issue for the DoD relative to discharge practices, dredging operations and clean-up techniques. Previous studies indicate that biological uptake, accumulation, and toxicity result primarily from the fraction of the toxicant pool that is readily solubilized. In surface sediments, the production of this soluble fraction will, in most cases, cause it to migrate through the pore water and across the sediment-water interface. Contaminated sediments at DoD sites pose a potential human health and ecological risk. Source control programs will not eliminate sediment contamination immediately because of the slow degradation and cycling processes that control many pollutants in these systems

For these reasons, benthic toxicant fluxes can provide a unique *in situ* indicator of bioavailability and hence an estimate of the potential for risk to human health or environmental harm. Using direct measurements, DoD can reduce the escalating costs of compliance and remediation of contaminated sediments by determining if the contamination poses a significant risk for remobilization. Quantifying the mobility of these in-place contaminants is an essential requirement for deciding the proper method of remediation. The complexity of marine sediment systems makes it very difficult to predict contaminant mobility by indirect methods. There is currently no other satisfactory direct means of quantifying the mobility of contaminants from marine sediments except the Benthic Flux Sampling Device (BFSD2 and its prototype version).

8.2 Transition

Technology transition of the BFSD2 is well underway. It consists of commercialization, regulatory acceptance, product improvement, and performance extension elements.

8.2.1 Commercialization

BFSD2 is a commercialized version of the prototype BFSD. The prototype BFSD was used during the Research, Development, Test and Evaluation (RDTE) phase of the program and was followed by fabrication of BFSD2 during the subsequent Acquisition phase. A Technical Data Package (TDP) and procurement package were generated to support a fixed-price, competitive contract solicitation for fabrication of a commercialized version of the prototype BFSD, called BFSD2. The winner, Ocean Sensors, Incorporated in San Diego, utilized commercial-off-the-shelf (COTS) and replaceable/repairable assemblies in meeting the requirements of the TDP.

8.2.1.1 Cooperative Research and Development Agreement

A Cooperative Research and Development Agreement (CRADA) was negotiated with Ocean Sensors, Inc., however it was not formalized and consummated. The company suggested, and SSC SD agreed, that a formal CRADA would not promote its goals for producing additional systems for other customers in response to market demand. No conflicting intellectual property issues were identified with their strategy and the company is currently awaiting new orders.

8.2.2 Regulatory Acceptance

See Approach to Regulatory Compliance and Acceptance, Section 7.1.

8.2.3 Product Improvement

Both incremental and continuing product improvements have been included in technology implementation. New methods, processes and procedures applicable to the BFSD2 were evaluated for use as a result of problems, constraints or other drawbacks identified during operations.

8.2.3.1 Incremental Product Improvements

Incremental improvements were implemented during the project, such as: reconfiguring the circulation pump for improved flow rate control: reconfiguring for *in situ* sample filtration using vacuum-filled collection bottles; installation of a insertion sensor subsystem to assure minimum sediment penetration; installation of a subsystem to inject sodium bromide into the collection chamber as a conservative tracer to facilitate more accurate volume determination. Care was taken to assure that such improvements did not invalidate ongoing certification efforts.

8.2.3.2 Continuing Product Improvements

Continuing improvements were implemented during the project, such as: method, timing and location for collection of a suitable ambient water sample; numerous computational spreadsheet data reduction, processing and display improvements; numerous improvements for turnaround cleaning and preparation; processes and procedures to improve maintenance and minimize corrosion. Again, care was taken to assure that such improvements did not invalidate ongoing certification efforts.

9. Lessons Learned

9.1 Flexibility

This project has been relatively straight forward and trouble free. As with any multi-faceted program which involves a complex new technology, flexibility must be maintained in order to accommodate any number of emergent issues. Plans and schedules must flex to allow for changes. This project suffered delayed funding at several points, but plans were flexible enough to allow work around efforts which ultimately recovered schedule losses. Technical approaches must flex to allow for changes. This project benefited from a number of incremental and continuing product improvements which were accommodated within the technical approach without invalidating demonstration results.

9.2 Mother Nature

Earlier studies had forecast it and it was clear from demonstration results that contaminated sediments are non-homogeneous and are subject to influences involving benthic organisms, complex marine geochemistry, and other factors. Accommodation of differences between blank measurements made a few days apart and site measurements made a few feet apart were necessary.

9.3 Statistics

With consideration for the very low levels of contaminants being measured (parts per *billion* and lower!) metrics involving statistical methods were needed to put meaning to results. Accommodation for results in terms of probabilities and confidence levels must be made to tease out the true meaning of some flux measurements. All throughout, consistent and repeatable materials, processes and procedures were necessary to minimize their influence on true results.

10. References

Key References

1. A.Tengberg, et al "Benthic Chamber and Profiling Landers in Oceanography - A Review of Design, Technical Solutions and Functioning"
2. A.Tengberg, et al,Draft - "Hydrodynamics in Benthic Chambers for *In Situ* Studies I: Results from an Intercalibration Involving 14 Different Designs", 8 Mar 1997
3. S.E.Bufflap and Herbert E. Allen, "Sediment Pore Water Collection Methods for Trace Metal Analysis: A Review", *Wat. Res.* Vol. 29, No. 1, pp 165-177, 1995
4. D.B.Chadwick, et al "A Benthic Flux Chamber for Monitoring Pollution Exchange Rates at the Sediment-Water Interface"
5. D.B.Chadwick, et al "Autonomous Benthic Lander for Polluted Bays, Harbors", *Sea Technology*
6. D.B.Chadwick, et al "An Instrument for the *In Situ* Measurement of Contaminant Flux Rates at the Sediment-water Interface", submitted to *Environmental Science and Technology*
7. J.M.Leather, et al "Contaminant Flux Measurements Across the Sediment-Water Interface in San Diego Bay", *Oceans '95*
8. NCCOSC RDTE Div, Code 52 Draft Final Report, "Sediment Quality Characterization - Naval Station San Diego", October 1996
9. NCCOSC RDTE DIV San Diego Contract N66001-97-C-0049 Awarded to Ocean Sensors, Inc., 21 Mar 1997
10. SPAWARSYSCEN San Diego contract N66001-98-D-5015 awarded to Tetra Tech, Inc., 26 August 1998
11. Technology Demonstration Plan for ESTCP Project 199712, *In Situ* Instrument for Quantifying Contaminant Mobility in marine Sediments, May 1998
12. California EPA Technical Report of Evaluation and Certification of Benthic Flux Sampling Device, Report TBD
13. ESTCP General Cost and Performance Report Guidance for Site Characterization Projects, June 1998 (Draft)
14. ESTCP Final Report Guidelines for Funded Projects, 15 April 1996

General References

1. Berelson, WM., D.E. Hammond, K.L. Hinga, G.T. Rowe, and F. Sayles, 1987. *In Situ* Benthic Flux Measurement Devices: Bottom Lander Technology. MTS Journal, V.21(2):26-32.
2. Berner, R.A., 1980. *Early Diagenesis: A Theoretical Approach*. Princeton University Press, Princeton, New Jersey, 241p.
3. Casas, A.M., and E.A. Crecelius, 1994. Relationship Between acid Volatile Sulfide and the Toxicity of Zinc, Lead, and Copper in Marine Sediments. Environmental Toxicology and Chemistry, V.13(3):529-536.
4. Chadwick, D.B., S.D. Stanley, and S.H. Lieberman, 1993. A Benthic Flux Chamber for Monitoring Pollution Exchange Rates at the Sediment-water Interface. Proceedings Oceans '93:196-206.
5. Di Toro, D.M., J.D. Mahony, D.J. Hansen, K.J. Scott, M.B. Hicks, S.M. Mayr, and M.S. Redmond, 1990. Toxicity of Cadmium in Sediments: the Role of Acid Volatile Sulfides. Environmental Toxicology and Chemistry, V. 9:1487-1502.
6. Huettel, M., and G. Gust, 1992. Solute Release Mechanisms from Confined Sediment Cores in Stirred Benthic Chambers and Flume Flows. Marine Ecology Service, V.82:187-197.
7. Rhoads, D.C., R.C. Aller, and M.B. Goldhaber, 1977. The Influence of Colonizing Benthos on Physical Properties and Chemical Diagenesis of the Estuarine Seafloor. In Coull, B.C. (ed), *Ecology of Marine Benthos*, University of South Carolina Press, Columbia, pp. 113-138.
8. Westerlund, S.F.G., L.G. Anderson, P.O.J. Hall, A. Iverfelt, M.M. Rutgers van der Loeff, and B. Sundy, 1986. Benthic Fluxes of Cadmium, Copper, Nickel, Zinc, and Lead in the Coastal Environment. Geochimica et Cosmochimica Acta, V.50:1289-1296.
9. Lee, C. and S.G. Wakeham, 1989. Organic Matter in Seawater: Biogeochemical Processes. In: J.P Riley (ed.), Chemical Oceanography, Academic Press, New York, pp.2-51.
10. NCCOSC RDTE Div Brochure TD 2790, "Benthic Flux Sampling Device", April 1995
11. R.F.Chen, et al "Benthic Fluxes of Organic Compounds by Time-resolved Spectrofluorometry"
12. NCCOSC RDTE Div Technical Document 2434, "An Evaluation of Contaminant Flux Rates from Sediments of Sinclair Inlet, WA, Using a Benthic Flux Sampling Device", February 1993
13. NCCOSC RDTE Div Technical Document 2435, "Benthic Flux Sampling Device Prototype Design, Development, and Evaluation", August 1993
14. NCCOSC RDTE Div Technical Document 2387, "Benthic Flux Sampling Device - Operations, Methods, and Procedures", February 1993
15. United States Environmental Protection Agency, 1988. Toxic Sediments: Approaches to Management. EPA 68-01-7002.

Appendix A

Points of Contact

1. Project Manager and Principal Investigator:

Combined Demo:

Bradley Davidson
Space and Naval Warfare Systems Center, Code D3604
53475 Strothe Road, Bldg 111
San Diego, CA 92152
Phone – 619-553-2804
Fax – 619-553-6305
Emai – bradley.davidson@navy.mil

Metals only and Organics only Demos:

Tom Hampton
Space and Naval Warfare Systems Center, Code D3604
53475 Strothe Road, Bldg 111
San Diego, CA 92152
Phone – 619-553-1172
Fax – 619-553-1177
Email – thampton@spawar.navy.mil

2. Co-Investigator:

Bart Chadwick, PhD
Space and Naval Warfare Systems Center, Code D362
53475 Strothe Road, Bldg 149
San Diego, CA 92152
Phone – 619-553-5333
Fax – 619-553-6305
Email – chadwick@spawar.navy.mil

3. California EPA Certification Evaluators:

Bruce Labelle, PhD
Department Of Toxic Substances Control
301 Capitol Mall, 1st floor
Sacramento, California 95814
Phone – 916-322-5591
Fax – 916-327-4494 or 445-2939
Email Blabelle@DTSC.Ca.Gov

John Wesnousky
Department of Toxic Substance Control
California Environmental Protection Agency
301 Capitol Mall, 1st Floor
Sacramento, CA 95814
Phone - 916-322-2543
Fax - 916-327-4494
Email JWesnousky@DTSC.Ca.Gov

4. Pearl Harbor Naval Complex Host:

Peter Nakamura
Naval Facilities Command, Pacific Division
Honolulu, HA
Phone – 808- 474-4505
Fax – 808- 474-4519
Email – NakamuraPM@efdpac.navfac.navy.mil

5. Commercialization Contractor:

Kim McCoy
Ocean Sensors, Inc
4901 Morena Blvd, Suite 1001
San Diego, CA 92117
Phone – 619-274-9893
Fax – 619-274-9895
Email – kmccoy@adnc.com

6. Development Sponsor:

Andy DelCollo
Naval Facilities Command
Washington DC
Phone – 202-685-9173
Fax – 202-685-1569
Email - delcolloa@navfac.navy.mil

7. Demonstration and Validation Sponsor:

Jeff Marqusee, Ph.D.
Office of Under Secretary of Defense (Environmental Security)
Environmental Security Technology Certification Program
Washington DC
Phone – 703-696-2120
Fax – 703-696-2114
Email - marqusj@acq.osd.mil

Appendix B

Spreadsheet Products for Each Demonstration

Bishop Point Combined - PAHs first 4 (Part 1)
Bishop Point Combined - PAHs first 4 (Part 2)
BP Organics Demo - PAHs (Part1)
BP Organics Demo - PAHs (Part1-First 4 Samples)
BP Organics Demo - PAHs (Part1-last 8 samples)
BP Organics Demo - PAHs (Part 2)
BP Organics Demo - PAHs (Part 2
BP Organics Demo - PAHs (Part 2
BP Organics Demo-PCBs
BP Organics Demo-Pesticides
PC Organics Demo - PAHs (Part1)
PC Organics Demo - PAHs (Part 2)
PC Organics Demo-PCBs
PC Organics Demo-Pesticides
BFSD2 Blank Tests (CA Cert)-Metals
BFSD2 Blank Tests- PAHs (CA Cert)
BFSD2 Blank Tests- PCBs (CA Cert)
BFSD2 Blank Tests- Pesticides (CA Cert)
BFSD2 PCD(All-CA Cert)
BFSD2 PCPD(All-CA Cert)
BFSD2 PHBP(All-CA Cert)
BFSD2 PHML(All-CA Cert)
Bishop Point Combined - Metals_1
Bishop Point Combined - PAHs (Part 1)
Bishop Point Combined - PAHs (Part 2)

BFSD 2 Triplicate Blank Tests
Copper

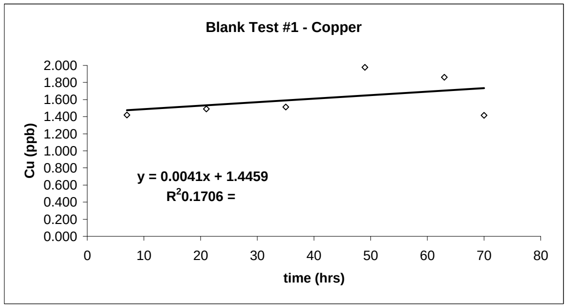
Site: End of SSC,SD Pier 159
Date: 5/14-5/31/98 (3 tests)

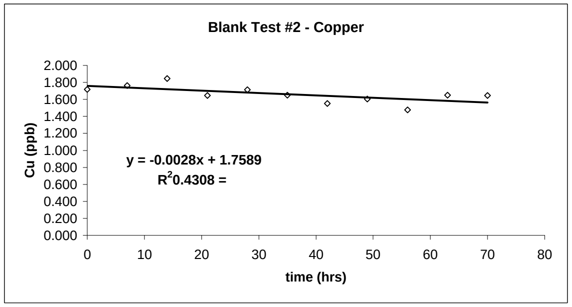
Start time: See indivdual tests
Duration/Interval: 77hrs (min)/7 hrs
End time: See individual tests

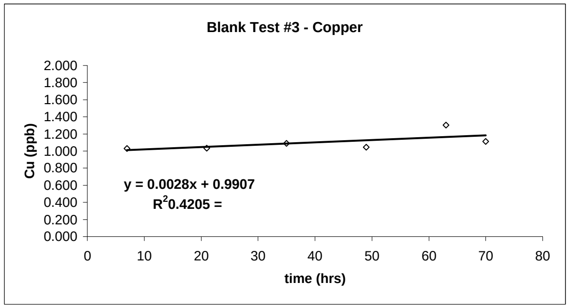
*Note: See individual tests for "Time 0 Ambient" sample id (Sample T-#0)

Bottle Volume =	0.235	liters
Blank Chamber Volume =	42.97	liters
Chamber Area =	1701.4	cm^2

	BFSD 2 Data			Dilution Correction			From	Linear Regression Statistics				
Sample id	Measured Concentration	Sample No.*	Elapsed Time	Measured Concentration	Corrected Concentration	# of Dilutions	Regression Concentration					
	(ppb)**		(hrs)	(ppb)**	(ppb)**		(ppb)**					
Copper (Cu)												
Test #1								Regression Output:				
	1.42	T-#0		1.420				Constant	1.446			
BT1-03	1.42	#1	7	1.420	1.420	0	1.475	Std Err of Y Est	0.211			
BT1-05	1.50	#2	21	1.500	1.492	2	1.532	R Squared	0.171			
BT1-07	1.53	#3	35	1.530	1.515	4	1.590	No. of Observations	6	Flux = 25 ug/m^2/day		
BT1-09	2.00	#4	49	2.000	1.978	6	1.648	Degrees of Freedom	4			
BT1-11	1.89	#5	63	1.890	1.863	8	1.705			80% CI (low) =	**-17**	$\mu g/m^2/day$
BT1-12	1.44	#6	70	1.440	1.416	9	1.734	X Coefficient(s)	0.004	(high) =	**67**	$\mu g/m^2/day$
								Std Err of Coef.	0.005			
Test #2												
								Regression Output:				
BT2-01	2.57	T-#0	-0.1	2.574		n/a		Constant	1.759			
BT2-02	1.72	#1	0	1.718	1.718	0	1.759	Std Err of Y Est	0.045			
BT2-03	1.77	#2	7	1.769	1.764	1	1.739	R Squared	0.431			
BT2-04	1.85	#3	14	1.853	1.844	2	1.719	No. of Observations	12	Flux = -17 ug/m^2/day		
BT2-05	1.66	#4	21	1.660	1.647	3	1.700	Degrees of Freedom	4			
BT2-06	1.73	#5	28	1.730	1.712	4	1.680			80% CI (low) =	**-27**	$\mu g/m^2/day$
BT2-07	1.67	#6	35	1.671	1.648	5	1.660	X Coefficient(s)	-0.003	(high) =	**-7**	$\mu g/m^2/day$
BT2-08	1.58	#7	42	1.579	1.551	6	1.640					
BT2-09	1.64	#8	49	1.639	1.606	7	1.621					
BT2-10	1.52	#9	56	1.515	1.477	8	1.601					
BT2-11	1.69	#10	63	1.693	1.649	9	1.581					
BT2-12	1.69	#11	70	1.693	1.644	10	1.561					
								Std Err of Coef.	0.001			
Test #3												
								Regression Output:				
	1.03	T-#0		1.030				Constant	0.991			
BT3-02	1.03	#1	7	1.030	1.030	0	1.010	Std Err of Y Est	0.075			
BT3-04	1.04	#2	21	1.040	1.034	2	1.049	R Squared	0.420			
BT3-06	1.10	#3	35	1.102	1.091	4	1.087	No. of Observations	6	Flux = 17 ug/m^2/day		
BT3-08	1.06	#4	49	1.063	1.047	6	1.126	Degrees of Freedom	4			
BT3-10	1.33	#5	63	1.326	1.304	8	1.164			80% CI (low) =	**2**	$\mu g/m^2/day$
BT3-12	1.14	#6	70	1.140	1.114	10	1.184	X Coefficient(s)	0.003	(high) =	**32**	$\mu g/m^2/day$
								Std Err of Coef.	0.002			







BFSD 2 Triplicate Blank Tests
Cadmium

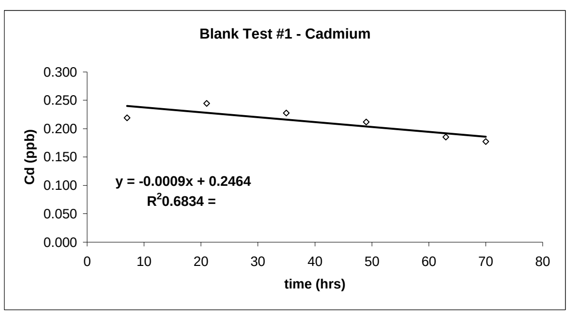
Site: End of SSC,SD Pier 159
Date: 5/14-5/31/98 (3 tests)

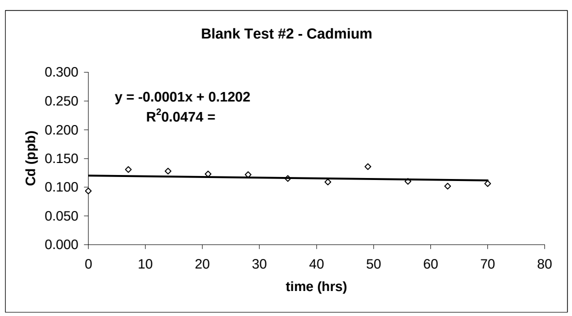
Start time: See indivdual tests
Duration/Interval: 77hrs (min)/7 hrs
End time: See individual tests

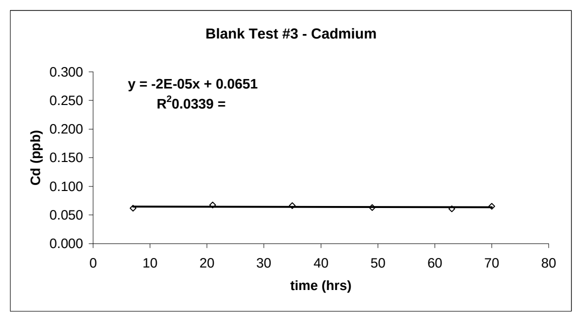
*Note: See individual tests for "Time 0 Ambient" sample id (Sample T-#0)

Bottle Volume = 0.235 liters
Blank Chamber Volume = 42.97 liters
Chamber Area = 1701.4 cm^2

Sample id	BFSD 2 Data: Measured Concentration (ppb)**	Sample No.*	Elapsed Time (hrs)	Dilution Correction: Measured Concentration (ppb)**	Corrected Concentration (ppb)**	# of Dilutions	From Regression Concentration (ppb)**	Linear Regression Statistics				
Cadmium (Cd)												
Test #1								Regression Output:				
	0.219	T-#0		0.219				Constant	0.246			
BT1-03	0.219	#1	7	0.219	0.219	0	0.240	Std Err of Y Est	0.014			
BT1-05	0.246	#2	21	0.246	0.245	2	0.228	R Squared	0.683			
BT1-07	0.230	#3	35	0.230	0.228	4	0.216	No. of Observations	6	Flux = -5.3 ug/m^2/day		
BT1-09	0.215	#4	49	0.215	0.212	6	0.204	Degrees of Freedom	4			
BT1-11	0.190	#5	63	0.190	0.185	8	0.192			80% CI (low) =	**-8.0**	µg/m²/day
BT1-12	0.182	#6	70	0.182	0.177	9	0.186	X Coefficient(s)	-0.001	(high) =	**-2.5**	µg/m²/day
								Std Err of Coef.	0.000			
Test #2								Regression Output:				
BT2-01	0.0752	T-#0	-0.1	0.075		n/a		Constant	0.120			
BT2-02	0.0937	#1	0	0.094	0.094	0	0.120	Std Err of Y Est	0.008			
BT2-03	0.131	#2	7	0.131	0.131	1	0.119	R Squared	0.047			
BT2-04	0.128	#3	14	0.128	0.128	2	0.118	No. of Observations	12	Flux = -0.7 ug/m^2/day		
BT2-05	0.122	#4	21	0.122	0.123	3	0.118	Degrees of Freedom	4			
BT2-06	0.121	#5	28	0.121	0.122	4	0.117			80% CI (low) =	**-2.5**	µg/m²/day
BT2-07	0.114	#6	35	0.114	0.115	5	0.116	X Coefficient(s)	0.000	(high) =	**1.0**	µg/m²/day
BT2-08	0.108	#7	42	0.108	0.109	6	0.115					
BT2-09	0.134	#8	49	0.134	0.136	7	0.114					
BT2-10	0.108	#9	56	0.108	0.110	8	0.113					
BT2-11	0.0998	#10	63	0.100	0.102	9	0.112					
BT2-12	0.104	#11	70	0.104	0.106	10	0.112					
								Std Err of Coef.	0.000			
Test #3								Regression Output:				
	0.0622	T-#0		0.062				Constant	0.065			
BT3-02	0.0622	#1	7	0.062	0.062	0	0.065	Std Err of Y Est	0.002			
BT3-04	0.0679	#2	21	0.068	0.068	2	0.065	R Squared	0.034			
BT3-06	0.0669	#3	35	0.067	0.066	4	0.064	No. of Observations	6	Flux = -0.12 ug/m^2/day		
BT3-08	0.0643	#4	49	0.064	0.063	6	0.064	Degrees of Freedom	4			
BT3-10	0.0623	#5	63	0.062	0.061	8	0.064			80% CI (low) =	**-0.59**	µg/m²/day
BT3-12	0.0670	#6	70	0.067	0.065	10	0.064	X Coefficient(s)	0.000	(high) =	**0.36**	µg/m²/day
								Std Err of Coef.	0.000			







BFSD 2 Triplicate Blank Tests
Lead

Site: End of SSC,SD Pier 159
Date: 5/14-5/31/98 (3 tests)

Start time: See indivdual tests
Duration/Interval: 77hrs (min)/7 hrs
End time: See individual tests

*Note: See individual tests for "Time 0 Ambient" sample id (Sample T-#0)

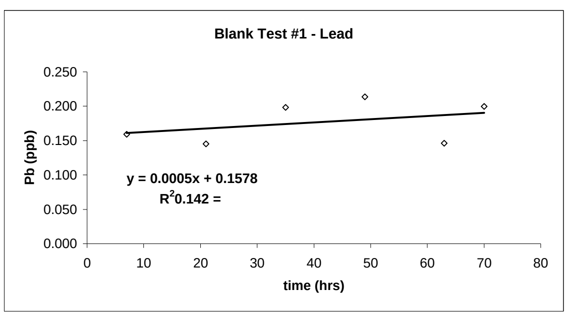
Bottle Volume =	0.235	liters
Blank Chamber Volume =	42.97	liters
Chamber Area =	1701.4	cm^2

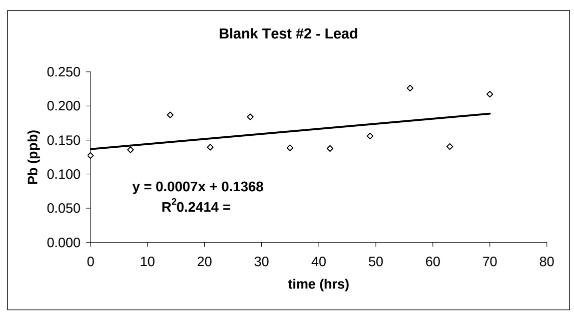
	BFSD 2 Data			Dilution Correction			From
Sample id	Measured Concentration	Sample No.*	Elapsed Time	Measured Concentration	Corrected Concentration	# of Dilutions	Regression Concentration
	(ppb)**		(hrs)	(ppb)**	(ppb)**		(ppb)**
Lead (Pb)							
Test #1							
	0.159	T-#0		0.159			
BT1-03	0.159	#1	7	0.159	0.159	0	0.161
BT1-05	0.146	#2	21	0.146	0.145	2	0.168
BT1-07	0.200	#3	35	0.200	0.198	4	0.174
BT1-09	0.216	#4	49	0.216	0.214	6	0.181
BT1-11	0.149	#5	63	0.149	0.146	8	0.187
BT1-12	0.203	#6	70	0.203	0.200	9	0.191
Test #2							
BT2-01	0.237	T-#0	-0.1	0.237		n/a	
BT2-02	0.128	#1	0	0.128	0.128	0	0.137
BT2-03	0.137	#2	7	0.137	0.136	1	0.142
BT2-04	0.188	#3	14	0.188	0.187	2	0.147
BT2-05	0.141	#4	21	0.141	0.140	3	0.152
BT2-06	0.186	#5	28	0.186	0.184	4	0.158
BT2-07	0.141	#6	35	0.141	0.138	5	0.163
BT2-08	0.141	#7	42	0.141	0.138	6	0.168
BT2-09	0.159	#8	49	0.159	0.156	7	0.173
BT2-10	0.230	#9	56	0.230	0.226	8	0.178
BT2-11	0.144	#10	63	0.144	0.140	9	0.183
BT2-12	0.221	#11	70	0.221	0.217	10	0.189
Test #3							
	0.108	T-#0		0.108			
BT3-02	0.108	#1	7	0.108	0.108	0	0.121
BT3-04	0.147	#2	21	0.147	0.146	2	0.123
BT3-06	0.123	#3	35	0.123	0.122	4	0.126
BT3-08	0.118	#4	49	0.118	0.116	6	0.128
BT3-10	0.138	#5	63	0.138	0.136	8	0.131
BT3-12	0.134	#6	70	0.134	0.132	10	0.132

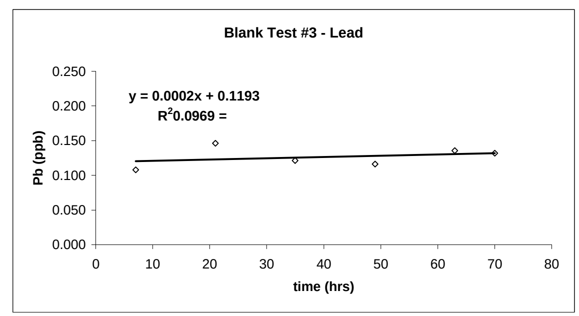
Linear Regression Statistics

Regression Output:	Test #1	Test #2	Test #3
Constant	0.158	0.137	0.119
Std Err of Y Est	0.027	0.018	0.013
R Squared	0.142	0.241	0.097
No. of Observations	6	12	6
Degrees of Freedom	4	4	4
X Coefficient(s)	0.000	0.001	0.000
Std Err of Coef.	0.001	0.000	0.000

	Test #1	Test #2	Test #3
Flux	**Flux = 2.8 ug/m^2/day**	**Flux = 4.5 ug/m^2/day**	**Flux = 1.1 ug/m^2/day**
80% CI (low) =	**-2.5** µg/m²/day	**0.4** µg/m²/day	**-1.5** µg/m²/day
(high) =	**8.2** µg/m²/day	**8.6** µg/m²/day	**3.6** µg/m²/day







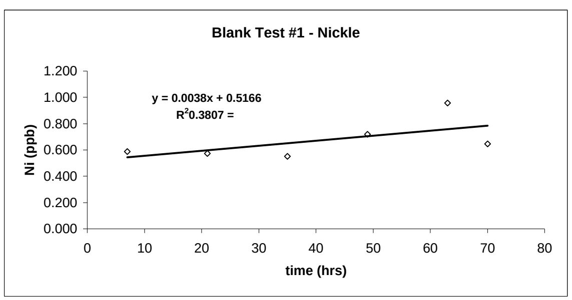
BFSD 2 Triplicate Blank Tests
Nickle

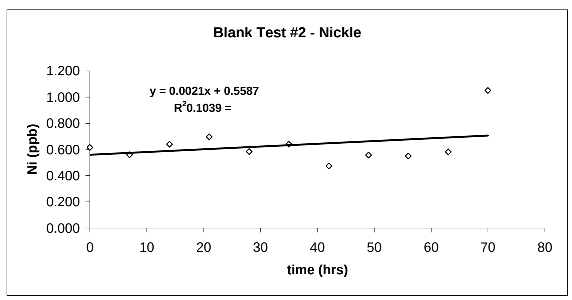
Site:	End of SSC,SD Pier 159	**Start time:**	See indivdual tests
Date:	5/14-5/31/98 (3 tests)	**Duration/Interval:**	77hrs (min)/7 hrs
		End time:	See individual tests

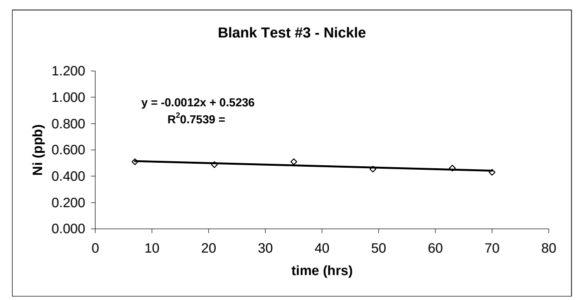
*Note: See individual tests for "Time 0 Ambient" sample id (Sample T-#0)

Bottle Volume =	0.235	liters
Blank Chamber Volume =	42.97	liters
Chamber Area =	1701.4	cm^2

	BFSD 2 Data			Dilution Correction			From	Linear Regression Statistics				
Sample id	**Measured Concentration** (ppb)**	**Sample No.***	**Elapsed Time** (hrs)	**Measured Concentration** (ppb)**	**Corrected Concentration** (ppb)**	**# of Dilutions**	**Regression Concentration** (ppb)**					
Nickle (Ni)												
Test #1								Regression Output:				
	0.589	T-#0		0.589				Constant	0.517			
BT1-03	0.589	#1	7	0.589	0.589	0	0.543	Std Err of Y Est	0.114			
BT1-05	0.577	#2	21	0.577	0.574	2	0.597	R Squared	0.381			
BT1-07	0.559	#3	35	0.559	0.552	4	0.651	No. of Observations	6	**Flux = 23 ug/m^2/day**		
BT1-09	0.730	#4	49	0.730	0.720	6	0.705	Degrees of Freedom	4			
BT1-11	0.970	#5	63	0.970	0.958	8	0.758			80% CI (low) =	**1**	$\mu g/m^2$/day
BT1-12	0.657	#6	70	0.657	0.647	9	0.785	X Coefficient(s)	0.004	(high) =	**46**	$\mu g/m^2$/day
								Std Err of Coef.	0.002			
Test #2												
								Regression Output:				
BT2-01	2.13	T-#0	-0.1	2.126		n/a		Constant	0.559			
BT2-02	0.615	#1	0	0.615	0.615	0	0.559	Std Err of Y Est	0.085			
BT2-03	0.568	#2	7	0.568	0.560	1	0.573	R Squared	0.104			
BT2-04	0.658	#3	14	0.658	0.641	2	0.588	No. of Observations	12	**Flux = 13 ug/m^2/day**		
BT2-05	0.721	#4	21	0.721	0.696	3	0.603	Degrees of Freedom	4			
BT2-06	0.618	#5	28	0.618	0.585	4	0.617			80% CI (low) =	**-6**	$\mu g/m^2$/day
BT2-07	0.681	#6	35	0.681	0.640	5	0.632	X Coefficient(s)	0.002	(high) =	**32**	$\mu g/m^2$/day
BT2-08	0.523	#7	42	0.523	0.474	6	0.647					
BT2-09	0.614	#8	49	0.614	0.556	7	0.661					
BT2-10	0.617	#9	56	0.617	0.551	8	0.676					
BT2-11	0.656	#10	63	0.656	0.582	9	0.691					
BT2-12	1.13	#11	70	1.134	1.052	10	0.705					
								Std Err of Coef.	0.002			
Test #3												
								Regression Output:				
	0.511	T-#0		0.511				Constant	0.524			
BT3-02	0.511	#1	7	0.511	0.511	0	0.515	Std Err of Y Est	0.016			
BT3-04	0.492	#2	21	0.492	0.489	2	0.499	R Squared	0.754			
BT3-06	0.516	#3	35	0.516	0.510	4	0.483	No. of Observations	6	**Flux = -7.1 ug/m^2/day**		
BT3-08	0.462	#4	49	0.462	0.454	6	0.466	Degrees of Freedom	4			
BT3-10	0.474	#5	63	0.474	0.462	8	0.450			80% CI (low) =	**-10.2**	$\mu g/m^2$/day
BT3-12	0.444	#6	70	0.444	0.429	10	0.442	X Coefficient(s)	-0.001	(high) =	**-4.0**	$\mu g/m^2$/day
								Std Err of Coef.	0.000			







BFSD 2 Triplicate Blank Tests
Manganese

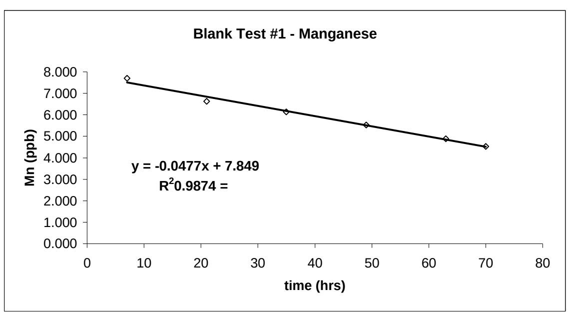
Site: End of SSC,SD Pier 159
Date: 5/14-5/31/98 (3 tests)

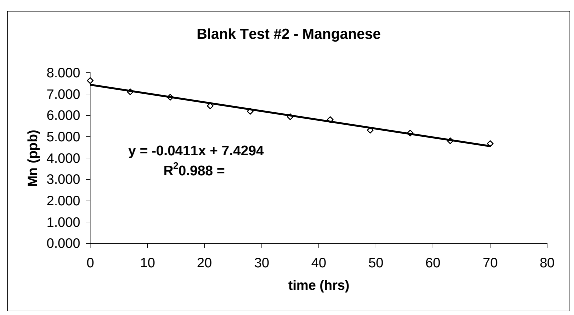
Start time: See indivdual tests
Duration/Interval: 77hrs (min)/7 hrs
End time: See individual tests

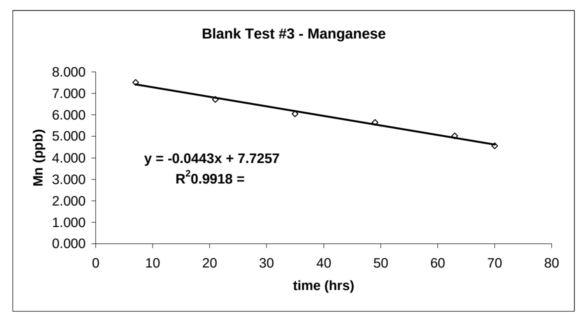
*Note: See individual tests for "Time 0 Ambient" sample id (Sample T-#0)

Bottle Volume =	0.235 liters
Blank Chamber Volume =	42.97 liters
Chamber Area =	1701.4 cm^2

	BFSD 2 Data			Dilution Correction			From	Linear Regression Statistics				
Sample id	**Measured Concentration**	**Sample No.***	**Elapsed Time**	**Measured Concentration**	**Corrected Concentration**	**# of Dilutions**	**Regression Concentration**					
	(ppb)**		(hrs)	(ppb)**	(ppb)**		(ppb)**					
Manganese(Mn)												
Test #1								Regression Output:				
	7.70	T-#0		7.700				Constant	7.849			
BT1-03	7.70	#1	7	7.700	7.700	0	7.515	Std Err of Y Est	0.125			
BT1-05	6.67	#2	21	6.670	6.628	2	6.847	R Squared	0.987			
BT1-07	6.23	#3	35	6.230	6.140	4	6.179	No. of Observations	6	**Flux = -289 ug/m^2/day**		
BT1-09	5.66	#4	49	5.660	5.520	6	5.512	Degrees of Freedom	4			
BT1-11	5.08	#5	63	5.080	4.887	8	4.844			80% CI (low) =	**-314**	μg/m²/day
BT1-12	4.74	#6	70	4.740	4.532	9	4.510	X Coefficient(s)	-0.048	(high) =	**-264**	μg/m²/day
								Std Err of Coef.	0.003			
Test #2								Regression Output:				
BT2-01	7.80	T-#0	-0.1	7.803		n/a		Constant	7.429			
BT2-02	7.63	#1	0	7.632	7.632	0	7.429	Std Err of Y Est	0.063			
BT2-03	7.10	#2	7	7.097	7.096	1	7.141	R Squared	0.988			
BT2-04	6.85	#3	14	6.854	6.849	2	6.853	No. of Observations	12	**Flux = -249 ug/m^2/day**		
BT2-05	6.45	#4	21	6.454	6.444	3	6.565	Degrees of Freedom	4			
BT2-06	6.20	#5	28	6.198	6.181	4	6.277			80% CI (low) =	**-263**	μg/m²/day
BT2-07	5.96	#6	35	5.961	5.935	5	5.989	X Coefficient(s)	-0.041	(high) =	**-235**	μg/m²/day
BT2-08	5.84	#7	42	5.837	5.801	6	5.702					
BT2-09	5.35	#8	49	5.349	5.302	7	5.414					
BT2-10	5.23	#9	56	5.232	5.172	8	5.126					
BT2-11	4.88	#10	63	4.877	4.803	9	4.838					
BT2-12	4.76	#11	70	4.761	4.671	10	4.550					
								Std Err of Coef.	0.002			
Test #3								Regression Output:				
	7.50	T-#0		7.503				Constant	7.726			
BT3-02	7.50	#1	7	7.503	7.503	0	7.416	Std Err of Y Est	0.094			
BT3-04	6.76	#2	21	6.762	6.721	2	6.795	R Squared	0.992			
BT3-06	6.14	#3	35	6.137	6.051	4	6.175	No. of Observations	6	**Flux = -269 ug/m^2/day**		
BT3-08	5.78	#4	49	5.777	5.642	6	5.555	Degrees of Freedom	4			
BT3-10	5.21	#5	63	5.208	5.023	8	4.934			80% CI (low) =	**-287**	μg/m²/day
BT3-12	4.80	#6	70	4.797	4.558	10	4.624	X Coefficient(s)	-0.044	(high) =	**-250**	μg/m²/day
								Std Err of Coef.	0.002			







BFSD 2 Triplicate Blank Tests
Zinc

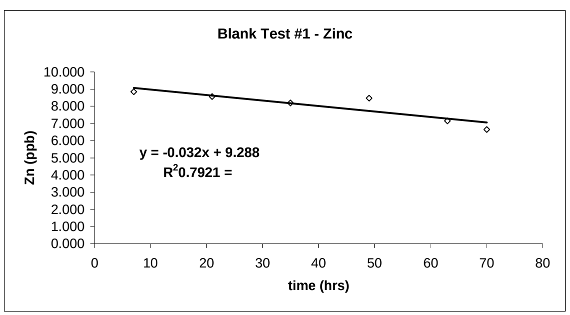
Site: End of SSC,SD Pier 159
Date: 5/14-5/31/98 (3 tests)

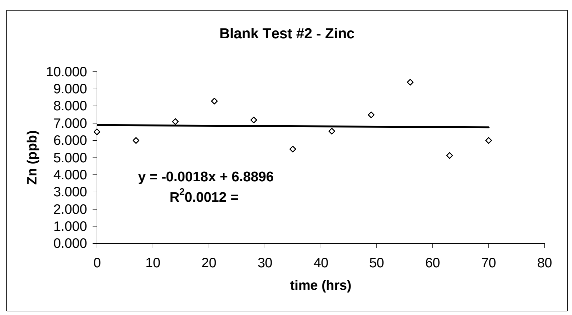
Start time: See indivdual tests
Duration/Interval: 77hrs (min)/7 hrs
End time: See individual tests

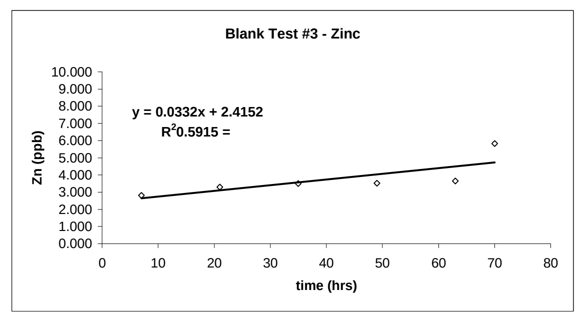
*Note: See individual tests for "Time 0 Ambient" sample id (Sample T-#0)

Bottle Volume =	0.235	liters
Blank Chamber Volume =	42.97	liters
Chamber Area =	1701.4	cm^2

	BFSD 2 Data			Dilution Correction			From	Linear Regression Statistics				
Sample id	**Measured Concentration** (ppb)**	**Sample No.***	**Elapsed Time** (hrs)	**Measured Concentration** (ppb)**	**Corrected Concentration** (ppb)**	**# of Dilutions**	**Regression Concentration** (ppb)**					
Zinc (Zn)												
Test #1								Regression Output:				
	8.85	T-#0		8.850				Constant	9.288			
BT1-03	8.85	#1	7	8.850	8.850	0	9.064	Std Err of Y Est	0.381			
BT1-05	8.61	#2	21	8.610	8.562	2	8.617	R Squared	0.792			
BT1-07	8.30	#3	35	8.300	8.202	4	8.169	No. of Observations	6	**Flux = -194 ug/m^2/day**		
BT1-09	8.63	#4	49	8.630	8.480	6	7.722	Degrees of Freedom	4			
BT1-11	7.35	#5	63	7.350	7.151	8	7.274			80% CI (low) =	**-270**	μg/m²/day
BT1-12	6.86	#6	70	6.860	6.653	9	7.051	X Coefficient(s)	-0.032	(high) =	**-118**	μg/m²/day
								Std Err of Coef.	0.008			
Test #2												
								Regression Output:				
BT2-01	6.04	T-#0	-0.1	6.037		n/a		Constant	6.890			
BT2-02	6.50	#1	0	6.497	6.497	0	6.890	Std Err of Y Est	0.742			
BT2-03	5.99	#2	7	5.992	5.995	1	6.877	R Squared	0.001			
BT2-04	7.10	#3	14	7.102	7.104	2	6.864	No. of Observations	12	**Flux = -11 ug/m^2/day**		
BT2-05	8.28	#4	21	8.276	8.284	3	6.851	Degrees of Freedom	4			
BT2-06	7.17	#5	28	7.173	7.193	4	6.838			80% CI (low) =	**-178**	μg/m²/day
BT2-07	5.46	#6	35	5.460	5.487	5	6.825	X Coefficient(s)	-0.002	(high) =	**155**	μg/m²/day
BT2-08	6.51	#7	42	6.510	6.533	6	6.812					
BT2-09	7.46	#8	49	7.458	7.484	7	6.799					
BT2-10	9.35	#9	56	9.349	9.383	8	6.787					
BT2-11	5.06	#10	63	5.064	5.116	9	6.774					
BT2-12	5.96	#11	70	5.955	6.002	10	6.761					
								Std Err of Coef.	0.018			
Test #3												
								Regression Output:				
	2.82	T-#0		2.817				Constant	2.415			
BT3-02	2.82	#1	7	2.817	2.817	0	2.647	Std Err of Y Est	0.641			
BT3-04	3.31	#2	21	3.313	3.298	2	3.112	R Squared	0.592			
BT3-06	3.52	#3	35	3.521	3.493	4	3.576	No. of Observations	6	**Flux = 201 ug/m^2/day**		
BT3-08	3.56	#4	49	3.558	3.518	6	4.040	Degrees of Freedom	4			
BT3-10	3.71	#5	63	3.708	3.657	8	4.504			80% CI (low) =	**73**	μg/m²/day
BT3-12	5.90	#6	70	5.895	5.833	10	4.737	X Coefficient(s)	0.033	(high) =	**329**	μg/m²/day
								Std Err of Coef.	0.014			







BFSD 2 Triplicate Blank Tests
Silica Dioxide

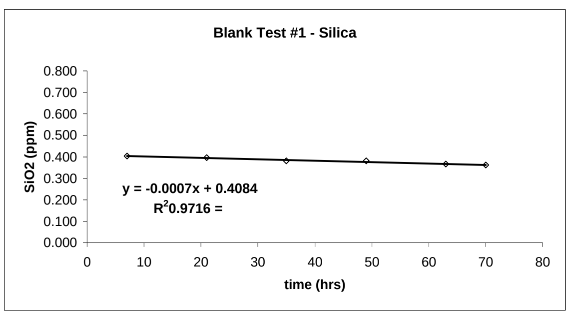
Site: End of SSC,SD Pier 159
Date: 5/14-5/31/98 (3 tests)

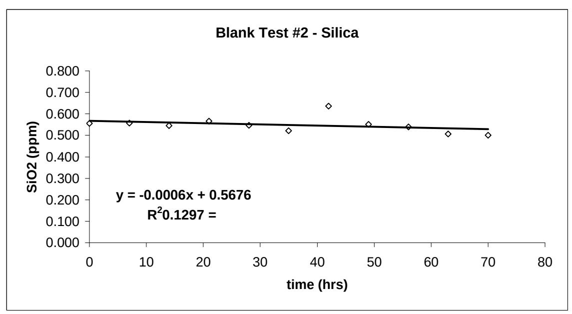
Start time: See indivdual tests
Duration/Interval: 77hrs (min)/7 hrs
End time: See individual tests

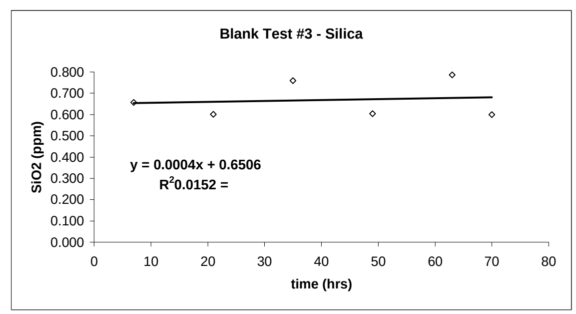
*Note: See individual tests for "Time 0 Ambient" sample id (Sample T-#0)

Bottle Volume =	0.235	liters
Blank Chamber Volume =	42.97	liters
Chamber Area =	1701.4	cm^2

Sample id	BFSD 2 Data: Measured Concentration (ppb)**	Sample No.*	Elapsed Time (hrs)	Dilution Correction: Measured Concentration (ppb)**	Corrected Concentration (ppb)**	# of Dilutions	From Regression Concentration (ppb)**	Linear Regression Statistics					
Silica (SiO_2)	**Concentrations are in ppm (mg/L)												
Test #1								Regression Output:					
	0.403	T-#0		0.403				Constant	0.408				
BT1-03	0.403	#1	7	0.403	0.403	0	0.404	Std Err of Y Est	0.003				
BT1-05	0.398	#2	21	0.398	0.396	2	0.395	R Squared	0.972				
BT1-07	0.386	#3	35	0.386	0.382	4	0.386	No. of Observations	6	Flux = -4.0 mg/m^2/day			
BT1-09	0.388	#4	49	0.388	0.381	6	0.376	Degrees of Freedom	4				
BT1-11	0.376	#5	63	0.376	0.367	8	0.367				80% CI (low) =	**-4.5**	$mg/m^2/day$
BT1-12	0.371	#6	70	0.371	0.362	9	0.363	X Coefficient(s)	-0.001		(high) =	**-3.4**	$mg/m^2/day$
								Std Err of Coef.	0.000				
Test #2								Regression Output:					
BT2-01	0.581	T-#0	-0.1	0.581		n/a		Constant	0.568				
BT2-02	0.556	#1	0	0.556	0.556	0	0.568	Std Err of Y Est	0.020				
BT2-03	0.557	#2	7	0.557	0.557	1	0.564	R Squared	0.130				
BT2-04	0.545	#3	14	0.545	0.545	2	0.560	No. of Observations	12	Flux = -3.4 mg/m^2/day			
BT2-05	0.566	#4	21	0.566	0.566	3	0.556	Degrees of Freedom	4				
BT2-06	0.548	#5	28	0.548	0.547	4	0.552				80% CI (low) =	**-7.9**	$mg/m^2/day$
BT2-07	0.523	#6	35	0.523	0.522	5	0.548	X Coefficient(s)	-0.001		(high) =	**1.1**	$mg/m^2/day$
BT2-08	0.638	#7	42	0.638	0.637	6	0.544						
BT2-09	0.552	#8	49	0.552	0.551	7	0.540						
BT2-10	0.540	#9	56	0.540	0.539	8	0.536						
BT2-11	0.508	#10	63	0.508	0.507	9	0.532						
BT2-12	0.503	#11	70	0.503	0.501	10	0.528						
								Std Err of Coef.	0.000				
Test #3								Regression Output:					
	0.657	T-#0		0.657				Constant	0.651				
BT3-02	0.657	#1	7	0.657	0.657	0	0.654	Std Err of Y Est	0.080				
BT3-04	0.605	#2	21	0.605	0.602	2	0.660	R Squared	0.015				
BT3-06	0.766	#3	35	0.766	0.759	4	0.665	No. of Observations	6	Flux = 2.6 mg/m^2/day			
BT3-08	0.614	#4	49	0.614	0.604	6	0.671	Degrees of Freedom	4				
BT3-10	0.801	#5	63	0.801	0.787	8	0.677				80% CI (low) =	**-13.3**	$mg/m^2/day$
BT3-12	0.617	#6	70	0.617	0.600	10	0.680	X Coefficient(s)	0.000		(high) =	**18.5**	$mg/m^2/day$
								Std Err of Coef.	0.002				







BATTELLE MARINE SCIENCES LABORATORY
1529 West Sequim Bay Road
Sequim, WA 98382-9099
360/681-3604

TETRA TECH
METALS IN SEAWATER
(Samples Received 6/3/98)

(concentrations in µg/L - not blank corrected)

MSL Code	Sponsor ID	Sb	As	Cd	Cu	Pb	Mn	Ni	Se	Ag	Tl	Zn
1225-2	BFSD2-BT1-3	0.125	1.25	0.219	1.42	0.159	7.70	0.589	0.568	0.0120	0.0113	8.85
1225-4	BFSD2-BT1-5	0.126	1.16	0.246	1.50	0.146	6.67	0.577	0.521	0.0151	0.0119	8.61
1225-6	BFSD2-BT1-7	0.121	1.18	0.230	1.53	0.200	6.23	0.559	0.488	0.0181	0.0115	8.30
1225-8	BFSD2-BT1-9	0.192	1.14	0.215	2.00	0.216	5.66	0.730	0.468	0.0120	0.0125	8.63
1225-10	BFSD2-BT1-11	0.142	1.10	0.190	1.89	0.149	5.08	0.970	0.452	0.0722	0.0118	7.35
1225-11	BFSD2-BT1-12	0.143	1.15	0.182	1.44	0.203	4.74	0.657	0.450	0.0181	0.0119	6.86
1225-12	BFSD2-BT2-EB	0.0168	0.00728 J	0.0120	0.376	0.0998	0.664 J	0.0522 J	0.0351 J	0.00903	0.000499 J	3.32
1225-13	BFSD2-BT2-SB	0.0248	0.00745 J	0.00750	0.169	4.33	0.689 J	0.0729 J	0.0248 J	0.0120	0.00121	0.984
1225-14	BFSD2-BT2-1	0.117	1.16	0.0752	2.57	0.237	7.80	2.13	0.372	0.00903	0.0109	6.04
1225-15	BFSD2-BT2-2	0.127	1.13	0.0937	1.72	0.128	7.63	0.615	0.519	0.0151	0.0110	6.50
1225-16	BFSD2-BT2-3	0.118	1.16	0.131	1.77	0.137	7.10	0.568	0.461	0.0181	0.0114	5.99
1225-17	BFSD2-BT2-4	0.124	1.14	0.128	1.85	0.188	6.85	0.658	0.410	0.0181	0.0111	7.10
1225-18	BFSD2-BT2-5	0.113	1.12	0.122	1.66	0.141	6.45	0.721	0.405	0.0181	0.0112	8.28
1225-19	BFSD2-BT2-6	0.0770	1.15	0.121	1.73	0.186	6.20	0.618	0.443	0.0151	0.0116	7.17
1225-20	BFSD2-BT2-7	0.0761	1.13	0.114	1.67	0.141	5.96	0.681	0.430	0.0120	0.0122	5.46
1225-21	BFSD2-BT2-8	0.104	1.13	0.108	1.58	0.141	5.84	0.523	0.454	0.0151	0.0114	6.51
1225-22	BFSD2-BT2-9	0.0551	1.09	0.134	1.64	0.159	5.35	0.614	0.427	0.0181	0.0117	7.46
1225-23	BFSD2-BT2-10	0.0783	1.10	0.108	1.52	0.230	5.23	0.617	0.407	0.0181	0.0118	9.35
1225-24	BFSD2-BT2-11	0.0689	1.16	0.0998	1.69	0.144	4.88	0.656	0.418	0.0120	0.0124	5.06
1225-25	BFSD2-BT2-12	0.0807	1.09	0.104	1.69	0.221	4.76	1.13	0.349	0.0120	0.0123	5.96
1225-27	BFSD2-BT3-2	0.0759	1.12	0.0622	1.03	0.108	7.50	0.511	0.453	0.0120	0.0113	2.82
1225-29	BFSD2-BT3-4	0.0750	1.05	0.0679	1.04	0.147	6.76	0.492	0.341	0.00903	0.0118	3.31
1225-31	BFSD2-BT3-6	0.130	1.03	0.0669	1.10	0.123	6.14	0.516	0.441	0.0151	0.0113	3.52
1225-33	BFSD2-BT3-8	0.0867	1.14	0.0643	1.06	0.118	5.78	0.462	0.435	0.0120	0.0121	3.56
1225-35	BFSD2-BT3-10	0.0612	1.12	0.0623	1.33	0.138	5.21	0.474	0.453	0.0120	0.0119	3.71
1225-37	BFSD2-BT3-12	0.125	1.10	0.0670	1.14	0.134	4.80	0.444	0.373	0.0120	0.0112	5.90
BLANKS												
1225-blk r1		0.0158	0.0227 J	0.000444 J	0.0420 J	0.00580 J	0.510 J	0.0165 J	0.0529 J	0.00903	0.00070 J	0.119 J
1225-blk r2		0.0145	0.0180 J	0.000611 J	0.0395 J	0.00800	0.596 J	0.0178 J	0.0212 J	0.00602	0.00054 J	0.140 J
Mean		0.0152	0.0204 J	0.000528 J	0.0407 J	0.00690	0.553 J	0.0171 J	0.0371 J	0.00753	0.00062 J	0.130 J
DETECTION LIMIT		0.01	0.12	0.007	0.076	0.006	0.87	0.08	0.16	0.00532	0.001	0.66

BATTELLE MARINE SCIENCES LABORATORY
1529 West Sequim Bay Road
Sequim, WA 98382-9099
360/681-3604

TETRA TECH
METALS IN SEAWATER
(Samples Received 6/3/98)

MSL Code	Sponsor ID	Sb	As	Cd	Cu	Pb	Mn	Ni	Se	Ag	Tl	Zn
		(concentrations in µg/L - not blank corrected)										
BLANK SPIKE RESULTS												
Amount Spiked		5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Mean Blank		0.0152	0.0204	0.00053 J	0.0407	0.00690	0.553	0.0171	0.0371	0.00753	0.00062 J	0.130
Blank Spike		3.66	2.98	3.69	4.31	4.60	5.07	4.30	1.26	2.12	4.70	4.61
Amount Recovered		3.64	2.96	3.69	4.27	4.59	4.52	4.29	1.22	2.11	4.69	4.48
Percent Recovery		73% #	59% #	74% #	85%	92%	90%	86%	24% #	42% #	94%	90%
Amount Spiked		5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Mean Blank		0.0152	0.0204	0.00053 J	0.0407	0.00690	0.553	0.0171	0.0371	0.00753	0.00062 J	0.130
Blank Spike Dup		3.84	3.04	3.64	4.38	4.69	5.19	4.53	1.61	2.09	4.87	4.64
Amount Recovered		3.83	3.01	3.63	4.34	4.68	4.64	4.51	1.57	2.08	4.87	4.51
Percent Recovery		77%	60% #	73% #	87%	94%	93%	90%	31% #	42% #	97%	90%
RPD		5%	2%	1%	2%	2%	3%	5%	25%	1%	4%	1%
MATRIX SPIKE RESULTS												
Amount Spiked		5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
1225-24		0.0689	1.16	0.0998	1.69	0.144	4.88	0.656	0.418	0.0120	0.0124	5.06
1225-24 MS		2.48	5.21	4.74	5.99	5.15	9.53	4.84	4.92	4.40	5.20	8.71
Amount Recovered		2.41	4.05	4.64	4.29	5.00	4.66	4.18	4.50	4.39	5.19	3.64
Percent Recovery		48% #	81%	93%	86%	100%	93%	84%	90%	88%	104%	73% #
Amount Spiked		5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
1225-24		0.0689	1.16	0.0998	1.69	0.144	4.88	0.656	0.418	0.0120	0.0124	5.06
1225-24 MSD		3.12	5.30	4.74	5.93	5.17	9.58	4.89	4.97	4.44	5.18	8.56
Amount Recovered		3.05	4.14	4.64	4.24	5.02	4.71	4.24	4.55	4.43	5.17	3.50
Percent Recovery		61% #	83%	93%	85%	100%	94%	85%	91%	89%	103%	70% #
RPD		24%	2%	0%	1%	0%	1%	1%	1%	1%	0%	4%

Print Date: 8/8/2008

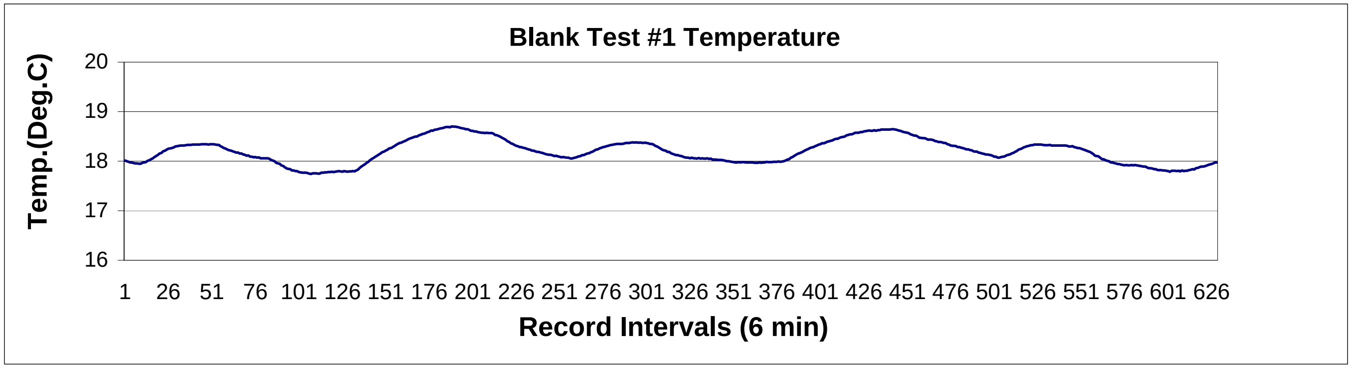
BATTELLE MARINE SCIENCES LABORATORY
1529 West Sequim Bay Road
Sequim, WA 98382-9099
360/681-3604

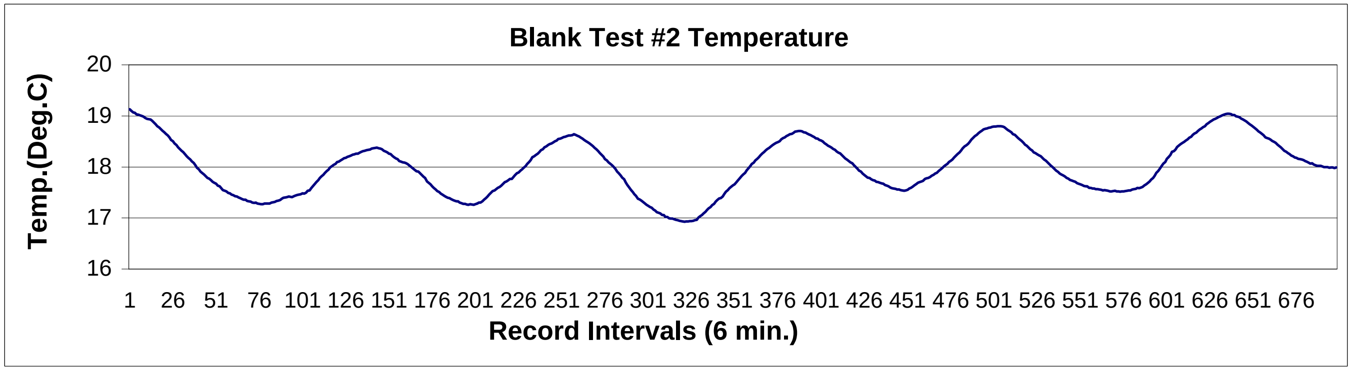
TETRA TECH
METALS IN SEAWATER
(Samples Received 6/3/98)

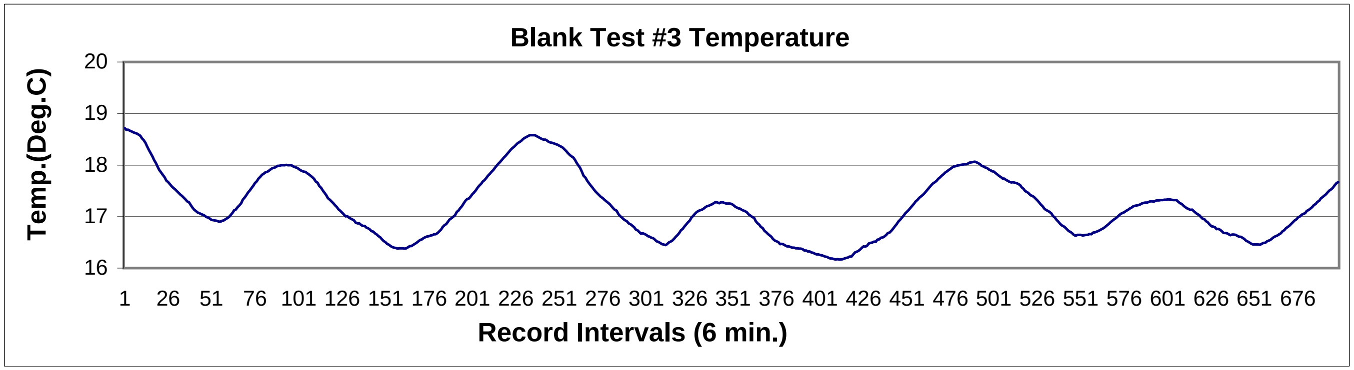
		(concentrations in µg/L - not blank corrected)										
MSL Code	Sponsor ID	Sb	As	Cd	Cu	Pb	Mn	Ni	Se	Ag	Tl	Zn
STANDARD REFERENCE MATERIAL												
cass3 r1		0.139	0.975	0.0339	0.550	0.0230	3.10	0.417	0.441	0.0120	0.0127	1.25
cass3 r2		0.112	0.961	0.0345	0.529	0.0230	3.03	0.400	0.404	0.0120	0.0119	1.21
	certified value	NC	1.09	0.030	0.517	0.0120	2.51	0.386	0.042 r	NC	NC	1.24
	range		±0.07	±0.005	±0.062	±0.004	±0.36	±0.062				±0.25
	percent difference	NA	11%	13%	6%	91% #	23%	8%	NA	NA	NA	1%
		NA	12%	15%	2%	91% #	21%	4%	NA	NA	NA	2%

#	Outside QA limits of ±25%
r	Reference value only; not certified
J	Value reported is below DL shown
NA	Not available/applicable
NC	Not certified
RPD	Relative percent difference

BFSD 2
Triplicate Blank Tests
Temperature

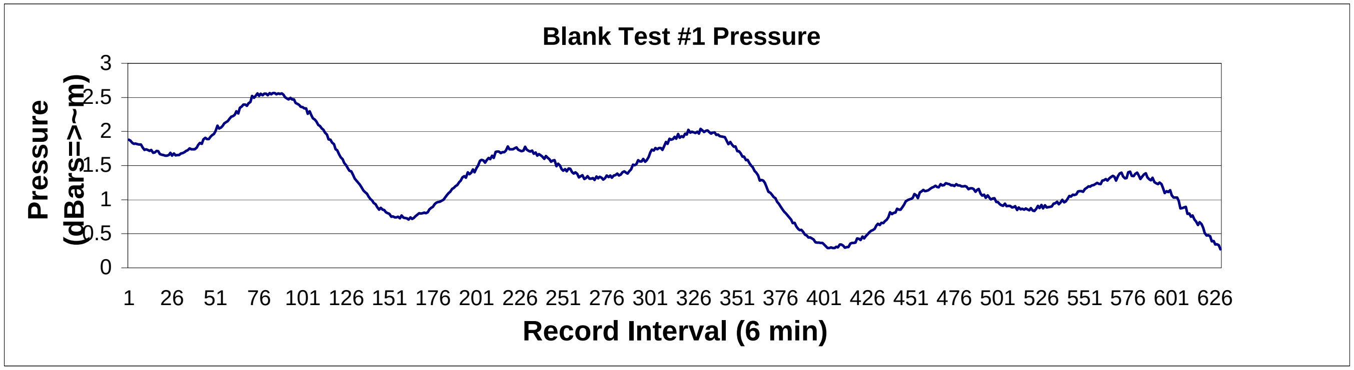


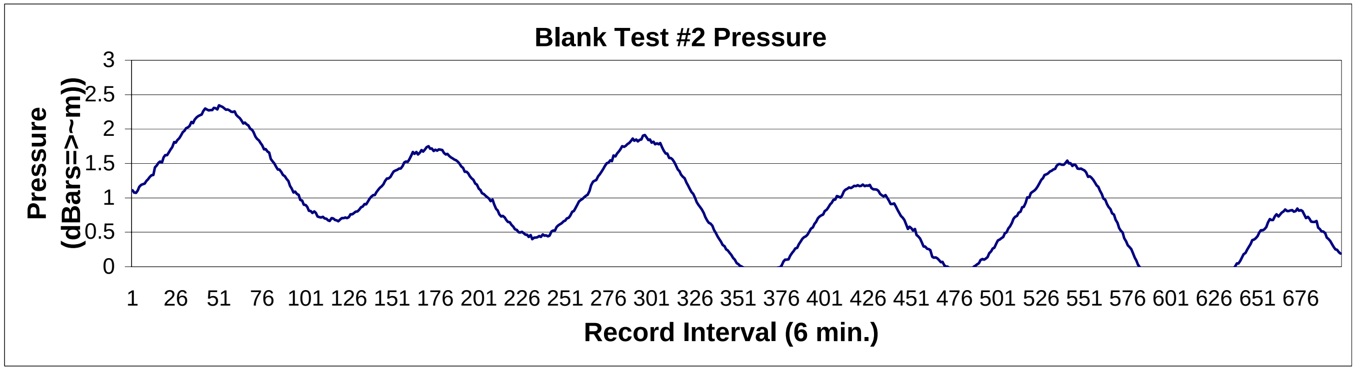


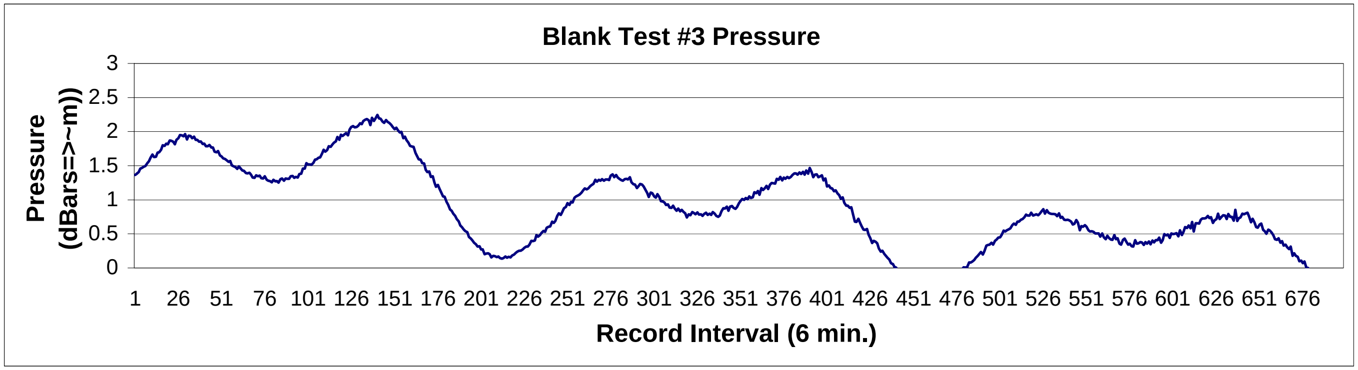


BFSD 2
Triplicate BlankTests
Pressure

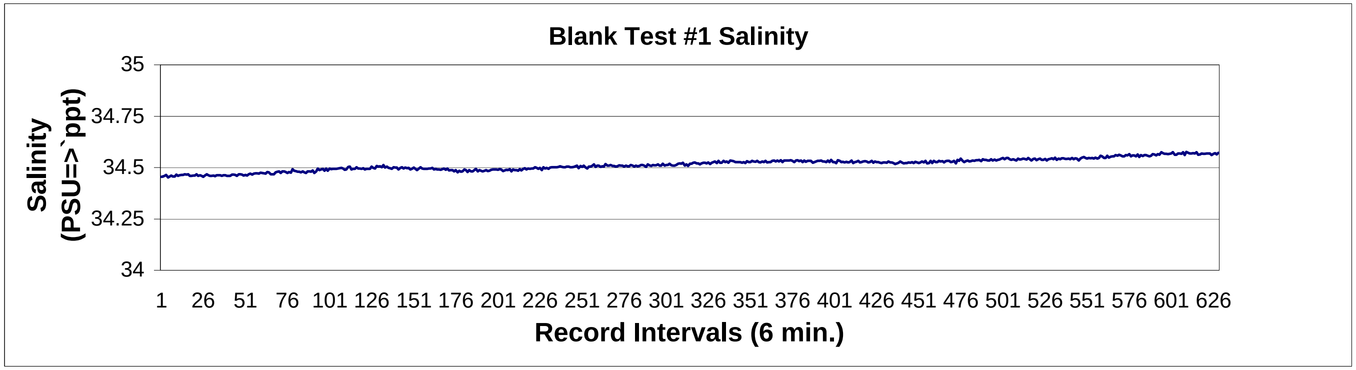
Note: Allow for (faulty) sensor drift
(subsequently corrected)

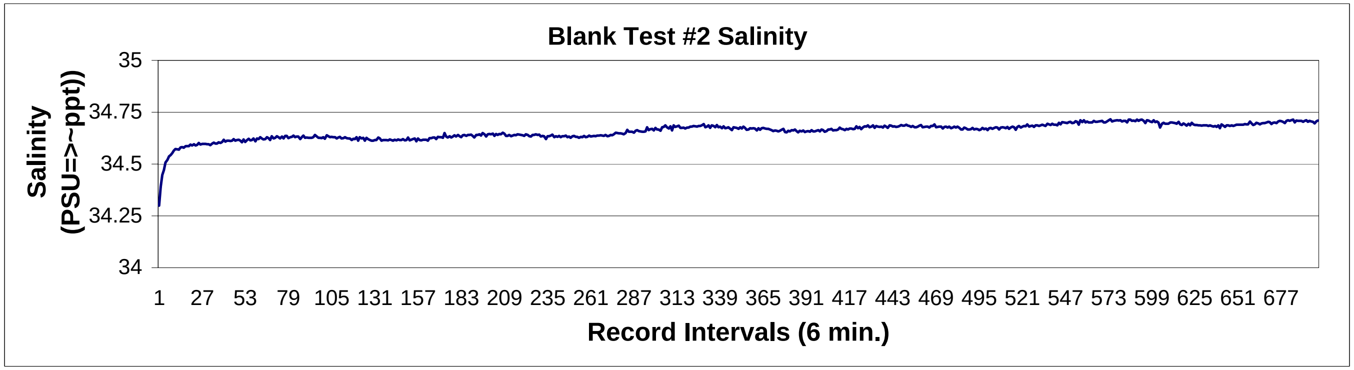


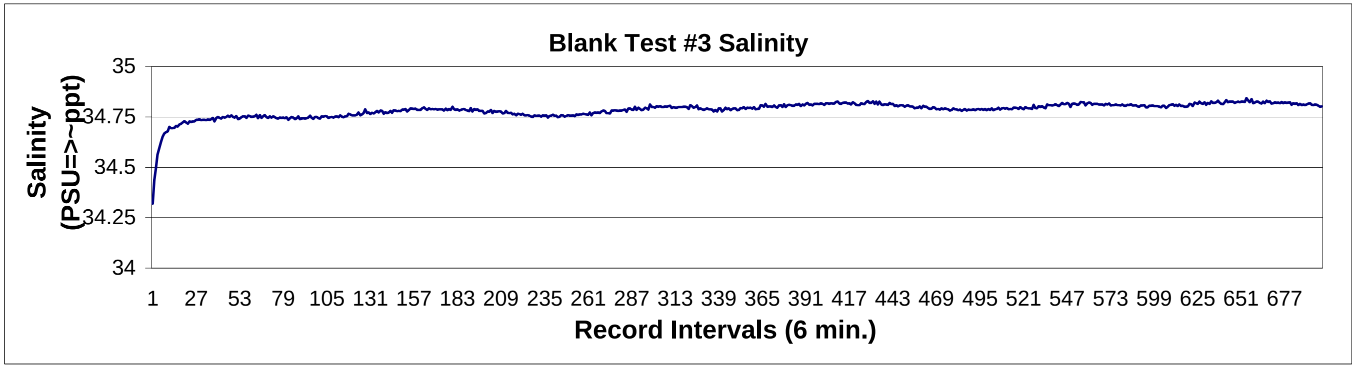




BFSD 2
Triplicate BlankTests
Salinity

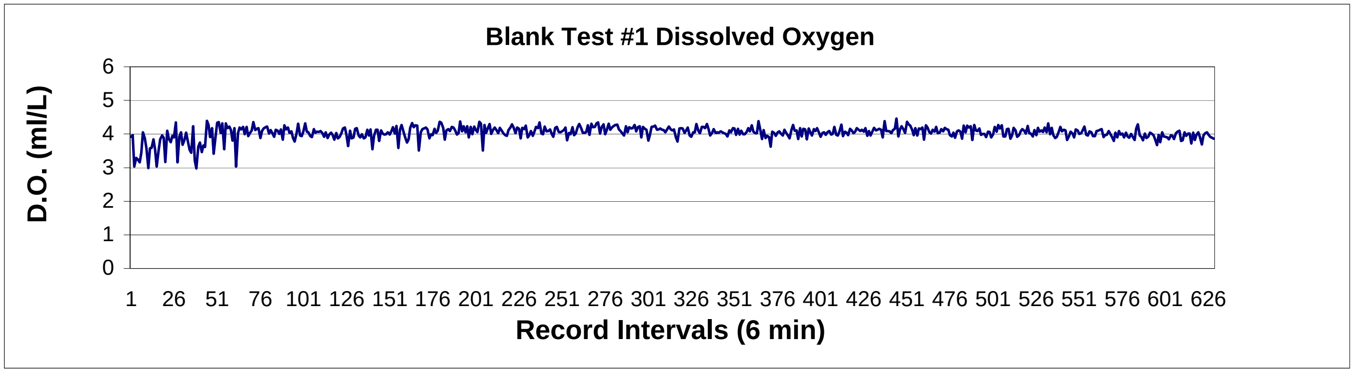


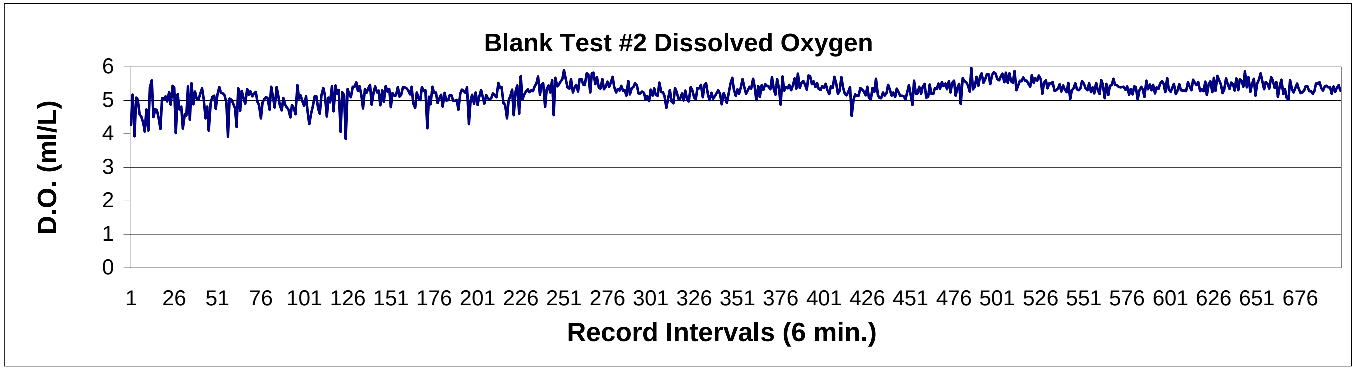


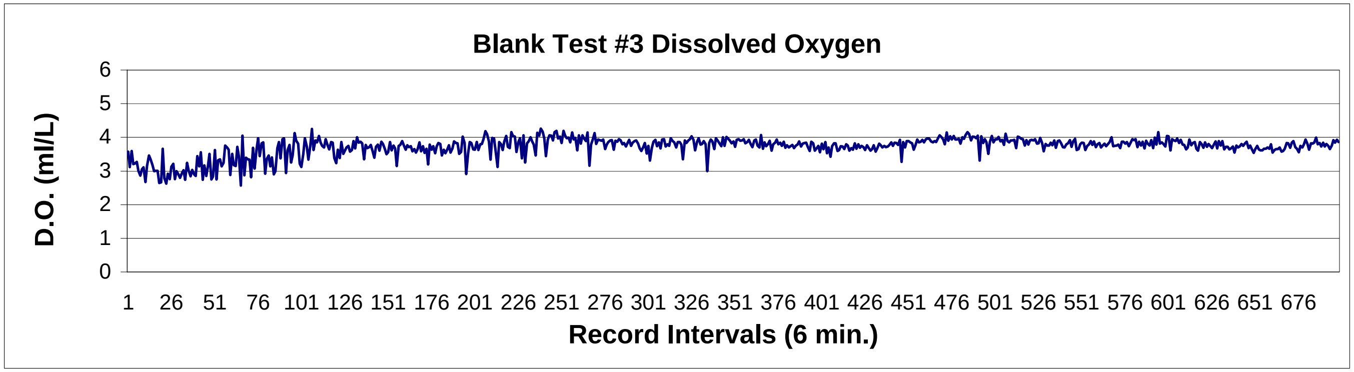


BFSD 2
Triplicate BlankTests
Dissolved Oxygen

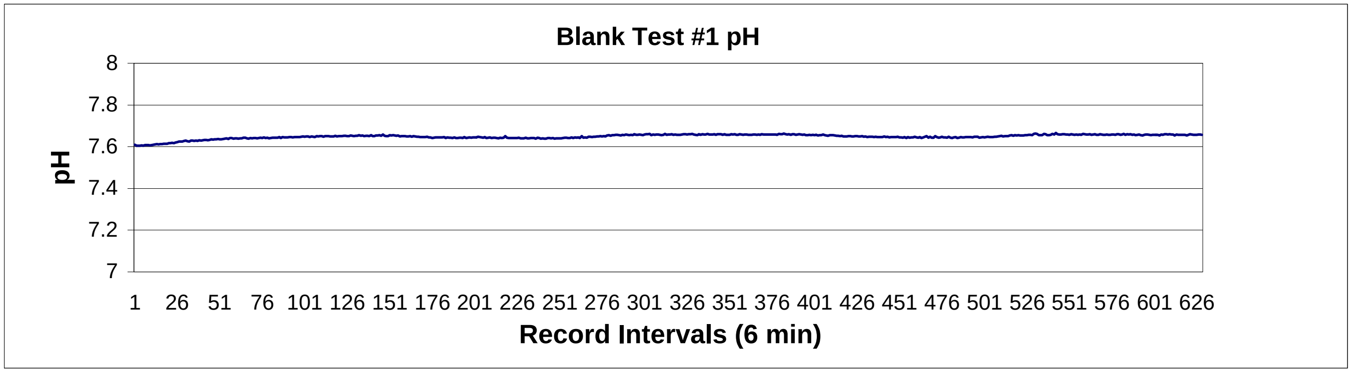
Note: "Noisey" traces due to restricted flow over sensor (subsequently corrected)

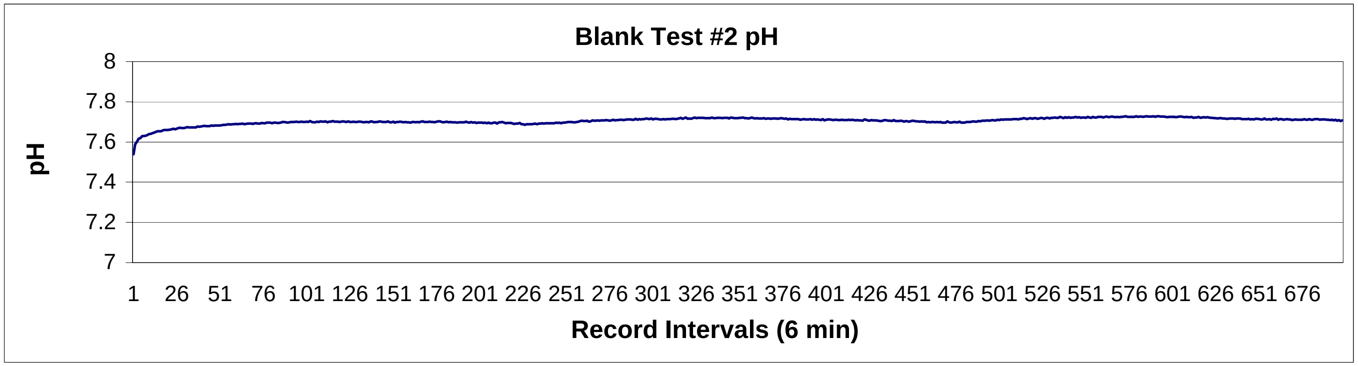


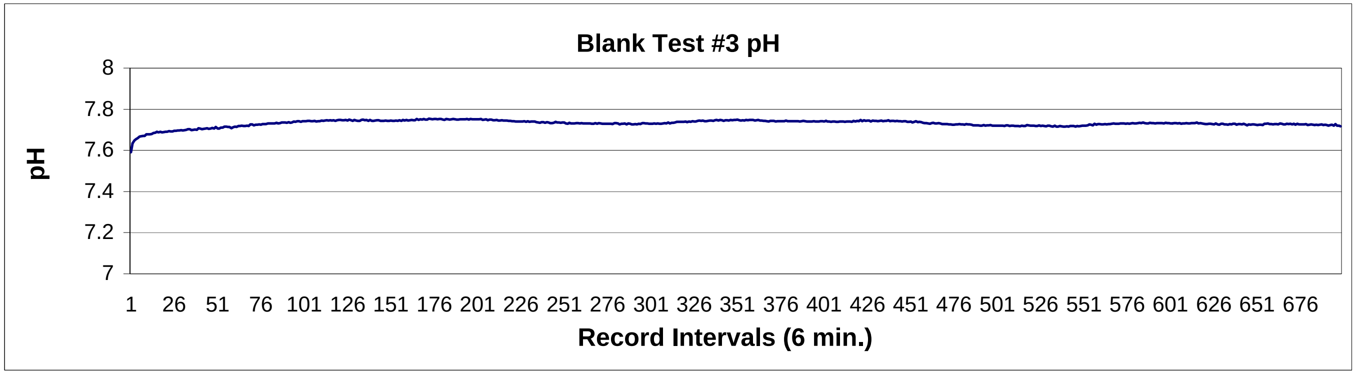




BFSD 2
Triplicate BlankTests
pH







Blank Test #1 Sensor Data

Record No.	Conductivity (mS/cm)	Temperature (Deg. C)	Pressure (dBar)	Salinity (PSU)	CTD Bat. (Vdc)	D.O. (Integer)	pH (Integer)	Date	Time	D.O. (ml/L)	pH (Value)
1	45.276	18.011	1.881	34.455	13.262	2339916	2456346	5/14/1998	14:34:30.70	3.917	7.610
2	45.265	17.998	1.866	34.457	13.312	2346641	2455075	5/14/1998	14:40:31.49	3.963	7.605
3	45.255	17.986	1.834	34.459	13.325	2211156	2455165	5/14/1998	14:46:32.28	3.034	7.605
4	45.248	17.972	1.817	34.464	13.334	2248927	2455032	5/14/1998	14:52:33.07	3.293	7.604
5	45.233	17.971	1.823	34.452	13.337	2241082	2455530	5/14/1998	14:58:33.86	3.239	7.607
6	45.227	17.96	1.813	34.457	13.342	2228945	2455191	5/14/1998	15:04:34.65	3.156	7.605
7	45.225	17.953	1.811	34.461	13.342	2270518	2455686	5/14/1998	15:10:35.44	3.441	7.607
8	45.222	17.955	1.808	34.457	13.344	2359142	2455926	5/14/1998	15:16:36.23	4.049	7.608
9	45.212	17.947	1.769	34.456	13.309	2333397	2455695	5/14/1998	15:22:37.02	3.873	7.607
10	45.223	17.946	1.731	34.466	13.334	2290483	2455503	5/14/1998	15:28:37.81	3.578	7.606
11	45.236	17.967	1.738	34.459	13.339	2204401	2455996	5/14/1998	15:34:38.60	2.987	7.609
12	45.245	17.971	1.73	34.463	13.34	2289578	2456336	5/14/1998	15:40:39.39	3.572	7.610
13	45.257	17.982	1.715	34.464	13.342	2291758	2456695	5/14/1998	15:46:40.18	3.587	7.612
14	45.279	18.004	1.73	34.464	13.343	2328554	2456877	5/14/1998	15:52:40.97	3.839	7.612
15	45.295	18.017	1.686	34.467	13.345	2284263	2456437	5/14/1998	15:58:41.76	3.535	7.610
16	45.317	18.041	1.69	34.465	13.345	2211735	2456885	5/14/1998	16:04:42.55	3.038	7.612
17	45.335	18.057	1.715	34.467	13.346	2279745	2456945	5/14/1998	16:10:43.34	3.504	7.613
18	45.356	18.087	1.709	34.46	13.346	2328233	2457334	5/14/1998	16:16:44.13	3.837	7.614
19	45.375	18.106	1.668	34.46	13.345	2346193	2457414	5/14/1998	16:22:44.92	3.960	7.615
20	45.401	18.131	1.661	34.461	13.348	2335558	2457412	5/14/1998	16:28:45.71	3.887	7.615
21	45.422	18.152	1.657	34.461	13.346	2230192	2458049	5/14/1998	16:34:46.50	3.164	7.617
22	45.447	18.17	1.646	34.467	13.347	2365600	2458046	5/14/1998	16:40:47.29	4.094	7.617
23	45.47	18.203	1.647	34.459	13.347	2332186	2458176	5/14/1998	16:46:48.08	3.864	7.618
24	45.488	18.216	1.654	34.463	13.347	2316255	2458154	5/14/1998	16:52:48.87	3.755	7.618
25	45.502	18.235	1.687	34.459	13.346	2343800	2458859	5/14/1998	16:58:49.66	3.944	7.621
26	45.511	18.249	1.646	34.455	13.346	2337673	2458981	5/14/1998	17:04:50.45	3.902	7.621
27	45.528	18.258	1.676	34.461	13.346	2402169	2459741	5/14/1998	17:10:51.24	4.345	7.625
28	45.541	18.263	1.648	34.468	13.345	2229313	2459899	5/14/1998	17:16:52.03	3.158	7.625
29	45.551	18.28	1.656	34.463	13.328	2341141	2459764	5/14/1998	17:22:52.82	3.926	7.625
30	45.563	18.295	1.657	34.46	13.336	2359001	2460457	5/14/1998	17:28:53.61	4.048	7.628
31	45.566	18.3	1.68	34.459	13.34	2305131	2460661	5/14/1998	17:34:54.40	3.679	7.629
32	45.577	18.309	1.682	34.461	13.339	2327314	2460177	5/14/1998	17:40:55.19	3.831	7.627
33	45.579	18.314	1.698	34.458	13.34	2357361	2459776	5/14/1998	17:46:55.98	4.037	7.625
34	45.586	18.316	1.714	34.462	13.339	2323358	2460836	5/14/1998	17:52:56.77	3.804	7.629
35	45.587	18.318	1.726	34.462	13.339	2282749	2460833	5/14/1998	17:58:57.56	3.525	7.629
36	45.593	18.322	1.752	34.463	13.34	2271057	2460620	5/14/1998	18:04:58.35	3.445	7.629
37	45.593	18.327	1.739	34.459	13.34	2386149	2460929	5/14/1998	18:10:59.14	4.235	7.630
38	45.6	18.329	1.737	34.463	13.339	2237429	2460319	5/14/1998	18:16:59.93	3.214	7.627
39	45.6	18.329	1.739	34.463	13.338	2202846	2460996	5/14/1998	18:23:00.72	2.977	7.630
40	45.602	18.336	1.763	34.459	13.339	2296880	2460929	5/14/1998	18:29:01.51	3.622	7.630
41	45.605	18.338	1.804	34.46	13.339	2314948	2461308	5/14/1998	18:35:02.30	3.746	7.632
42	45.604	18.336	1.831	34.46	13.338	2273005	2461633	5/14/1998	18:41:03.09	3.458	7.633
43	45.607	18.333	1.82	34.466	13.336	2302834	2461552	5/14/1998	18:47:03.88	3.663	7.633
44	45.609	18.335	1.883	34.465	13.337	2295581	2461217	5/14/1998	18:53:04.67	3.613	7.631
45	45.612	18.339	1.906	34.464	13.337	2409399	2461591	5/14/1998	18:59:05.46	4.394	7.633
46	45.611	18.345	1.888	34.459	13.336	2391571	2462197	5/14/1998	19:05:06.25	4.272	7.635
47	45.616	18.339	1.889	34.468	13.336	2338360	2461855	5/14/1998	19:11:07.04	3.907	7.634
48	45.617	18.341	1.922	34.468	13.336	2377738	2462122	5/14/1998	19:17:07.83	4.177	7.635
49	45.611	18.338	1.946	34.465	13.338	2266786	2462090	5/14/1998	19:23:08.62	3.415	7.635
50	45.607	18.339	1.966	34.461	13.336	2340669	2462577	5/14/1998	19:29:09.41	3.922	7.637
51	45.612	18.339	2.004	34.464	13.335	2401428	2462098	5/14/1998	19:35:10.20	4.339	7.635
52	45.608	18.34	2.084	34.461	13.335	2403924	2462223	5/14/1998	19:41:10.99	4.357	7.635
53	45.61	18.335	2.042	34.467	13.337	2356018	2462593	5/14/1998	19:47:11.78	4.028	7.637
54	45.606	18.326	2.059	34.47	13.333	2397528	2462807	5/14/1998	19:53:12.57	4.313	7.638
55	45.6	18.327	2.081	34.465	13.333	2285816	2463198	5/14/1998	19:59:13.36	3.546	7.640
56	45.584	18.303	2.117	34.471	13.333	2398260	2462569	5/14/1998	20:05:14.15	4.318	7.637
57	45.567	18.285	2.137	34.472	13.332	2377051	2463576	5/14/1998	20:11:14.94	4.172	7.641
58	45.544	18.263	2.153	34.472	13.331	2383918	2463667	5/14/1998	20:17:15.73	4.219	7.642
59	45.531	18.25	2.191	34.471	13.331	2368433	2463074	5/14/1998	20:23:16.52	4.113	7.639
60	45.52	18.235	2.219	34.475	13.331	2323805	2463263	5/14/1998	20:29:17.31	3.807	7.640
61	45.504	18.221	2.226	34.473	13.331	2376991	2463289	5/14/1998	20:35:18.10	4.172	7.640
62	45.493	18.21	2.244	34.472	13.333	2210825	2463077	5/14/1998	20:41:18.89	3.031	7.639
63	45.48	18.2	2.297	34.47	13.33	2355678	2463360	5/14/1998	20:47:19.68	4.025	7.640
64	45.477	18.187	2.263	34.478	13.33	2379611	2463320	5/14/1998	20:53:20.47	4.190	7.640
65	45.465	18.176	2.349	34.476	13.331	2371687	2464053	5/14/1998	20:59:21.26	4.135	7.643
66	45.452	18.173	2.369	34.468	13.327	2383050	2464100	5/14/1998	21:05:22.05	4.213	7.644
67	45.437	18.158	2.397	34.468	13.327	2351063	2463189	5/14/1998	21:11:22.84	3.994	7.640
68	45.43	18.152	2.397	34.467	13.326	2383023	2463037	5/14/1998	21:17:23.63	4.213	7.639
69	45.422	18.133	2.375	34.477	13.326	2343310	2463752	5/14/1998	21:23:24.42	3.941	7.642
70	45.417	18.126	2.416	34.479	13.328	2355325	2463448	5/14/1998	21:29:25.21	4.023	7.641
71	45.406	18.112	2.431	34.481	13.327	2367457	2463585	5/14/1998	21:35:26.00	4.106	7.641
72	45.401	18.116	2.52	34.473	13.324	2403576	2463594	5/14/1998	21:42:08.00	4.354	7.641
73	45.388	18.093	2.496	34.481	13.324	2369041	2463392	5/14/1998	21:48:08.79	4.117	7.641
74	45.387	18.091	2.521	34.482	13.323	2373998	2463809	5/14/1998	21:54:09.58	4.151	7.642
75	45.37	18.078	2.559	34.478	13.324	2377182	2463890	5/14/1998	22:00:10.37	4.173	7.643
76	45.371	18.084	2.524	34.474	13.324	2334801	2463724	5/14/1998	22:06:11.16	3.882	7.642
77	45.365	18.074	2.555	34.478	13.322	2365159	2464469	5/14/1998	22:12:11.95	4.091	7.645
78	45.363	18.076	2.533	34.475	13.323	2375688	2463809	5/14/1998	22:18:12.74	4.163	7.642
79	45.362	18.055	2.555	34.492	13.323	2381254	2464032	5/14/1998	22:24:13.53	4.201	7.643
80	45.357	18.059	2.556	34.484	13.325	2384078	2463464	5/14/1998	22:30:14.32	4.220	7.641
81	45.354	18.057	2.53	34.483	13.322	2353772	2463593	5/14/1998	22:36:15.11	4.012	7.641
82	45.349	18.055	2.563	34.48	13.321	2368779	2463860	5/14/1998	22:42:15.90	4.115	7.643
83	45.348	18.056	2.543	34.479	13.321	2356085	2463896	5/14/1998	22:48:16.69	4.028	7.643
84	45.342	18.053	2.566	34.476	13.32	2340172	2464056	5/14/1998	22:54:17.48	3.919	7.643
85	45.323	18.027	2.562	34.482	13.32	2370278	2463957	5/14/1998	23:00:18.27	4.126	7.643
86	45.306	18.016	2.546	34.477	13.319	2366424	2464550	5/14/1998	23:06:19.06	4.099	7.646
87	45.287	17.999	2.558	34.474	13.318	2352180	2463720	5/14/1998	23:12:19.85	4.001	7.642
88	45.264	17.968	2.552	34.481	13.318	2372135	2464649	5/14/1998	23:18:20.64	4.138	7.646
89	45.252	17.955	2.558	34.482	13.318	2327818	2464429	5/14/1998	23:24:21.43	3.834	7.645
90	45.24	17.946	2.539	34.48	13.319	2389883	2464399	5/14/1998	23:30:22.22	4.260	7.645
91	45.22	17.917	2.504	34.486	13.319	2371560	2464360	5/14/1998	23:36:23.01	4.134	7.645

Record No.	Conductivity (mS/cm)	Temperature (Deg. C)	Pressure (dBar)	Salinity (PSU)	CTD Bat. (Vdc)	D.O. (Integer)	pH (Integer)	Date	Time	D.O. (ml/L)	pH (Value)
92	45.193	17.905	2.486	34.474	13.316	2380525	2464586	5/14/1998	23:42:23.80	4.196	7.646
93	45.174	17.876	2.47	34.482	13.315	2356383	2464819	5/14/1998	23:48:24.59	4.030	7.647
94	45.165	17.852	2.495	34.495	13.316	2363233	2464439	5/14/1998	23:54:25.38	4.077	7.645
95	45.152	17.847	2.471	34.488	13.315	2334303	2464571	5/15/1998	00:00:26.17	3.879	7.646
96	45.145	17.836	2.471	34.491	13.315	2318677	2464603	5/15/1998	00:06:26.96	3.772	7.646
97	45.126	17.815	2.42	34.493	13.314	2354618	2464559	5/15/1998	00:12:27.75	4.018	7.646
98	45.112	17.811	2.403	34.484	13.315	2396418	2464540	5/15/1998	00:18:28.54	4.305	7.645
99	45.111	17.797	2.39	34.495	13.313	2345937	2465214	5/15/1998	00:24:29.33	3.959	7.648
100	45.1	17.797	2.364	34.485	13.314	2343263	2465354	5/15/1998	00:30:30.12	3.940	7.649
101	45.095	17.781	2.36	34.496	13.314	2361929	2464998	5/15/1998	00:36:30.91	4.068	7.647
102	45.085	17.776	2.338	34.492	13.312	2397693	2465248	5/15/1998	00:42:31.70	4.314	7.649
103	45.082	17.77	2.339	34.494	13.313	2361991	2465327	5/15/1998	00:48:32.49	4.069	7.649
104	45.077	17.766	2.26	34.493	13.311	2359765	2464850	5/15/1998	00:54:33.28	4.054	7.647
105	45.078	17.765	2.297	34.494	13.311	2343112	2465278	5/15/1998	01:00:34.07	3.939	7.649
106	45.073	17.759	2.24	34.495	13.31	2339118	2465036	5/15/1998	01:06:34.86	3.912	7.648
107	45.067	17.75	2.192	34.497	13.309	2373443	2464837	5/15/1998	01:12:35.65	4.147	7.647
108	45.06	17.743	2.175	34.498	13.309	2358277	2465788	5/15/1998	01:18:36.44	4.043	7.651
109	45.069	17.754	2.147	34.495	13.309	2361881	2465250	5/15/1998	01:24:37.23	4.068	7.649
110	45.061	17.754	2.095	34.489	13.308	2360513	2465788	5/15/1998	01:30:38.02	4.059	7.651
111	45.064	17.755	2.082	34.491	13.308	2365125	2465730	5/15/1998	01:36:38.81	4.090	7.651
112	45.071	17.748	2.043	34.503	13.308	2354717	2465046	5/15/1998	01:42:39.60	4.019	7.648
113	45.076	17.75	2.024	34.505	13.307	2339792	2465843	5/15/1998	01:48:40.39	3.916	7.651
114	45.074	17.767	1.981	34.49	13.307	2359431	2465605	5/15/1998	01:54:41.18	4.051	7.650
115	45.077	17.765	1.954	34.493	13.308	2334336	2465603	5/15/1998	02:00:41.97	3.879	7.650
116	45.085	17.773	1.883	34.493	13.308	2349904	2465524	5/15/1998	02:06:42.76	3.986	7.650
117	45.092	17.771	1.879	34.501	13.307	2357965	2465475	5/15/1998	02:12:43.55	4.041	7.650
118	45.096	17.781	1.838	34.496	13.307	2346763	2465589	5/15/1998	02:18:44.34	3.964	7.650
119	45.096	17.782	1.815	34.495	13.306	2327530	2466033	5/15/1998	02:24:45.13	3.832	7.652
120	45.095	17.785	1.74	34.493	13.307	2356530	2465461	5/15/1998	02:30:45.92	4.031	7.649
121	45.099	17.783	1.727	34.497	13.308	2333205	2465944	5/15/1998	02:36:46.71	3.871	7.652
122	45.093	17.785	1.662	34.491	13.306	2337882	2465861	5/15/1998	02:42:47.50	3.903	7.651
123	45.106	17.795	1.62	34.494	13.305	2355699	2465839	5/15/1998	02:48:48.29	4.026	7.651
124	45.108	17.797	1.596	34.493	13.306	2375615	2466033	5/15/1998	02:54:49.08	4.162	7.652
125	45.107	17.795	1.538	34.494	13.304	2380729	2466074	5/15/1998	03:00:49.87	4.197	7.652
126	45.113	17.79	1.505	34.504	13.303	2346873	2465608	5/15/1998	03:06:50.66	3.965	7.650
127	45.117	17.799	1.463	34.498	13.303	2299817	2465916	5/15/1998	03:12:51.45	3.642	7.651
128	45.108	17.795	1.426	34.496	13.302	2365956	2466497	5/15/1998	03:18:52.24	4.096	7.654
129	45.115	17.786	1.414	34.508	13.302	2333427	2466179	5/15/1998	03:24:53.03	3.873	7.653
130	45.115	17.791	1.368	34.504	13.302	2337033	2465739	5/15/1998	03:30:53.82	3.898	7.651
131	45.121	17.793	1.31	34.507	13.303	2374985	2466073	5/15/1998	03:36:54.61	4.158	7.652
132	45.125	17.803	1.281	34.502	13.302	2376677	2466292	5/15/1998	03:42:55.40	4.170	7.653
133	45.126	17.792	1.249	34.512	13.302	2345688	2466780	5/15/1998	03:48:56.19	3.957	7.655
134	45.133	17.814	1.217	34.5	13.301	2336899	2466162	5/15/1998	03:54:56.98	3.897	7.653
135	45.148	17.825	1.183	34.504	13.301	2351237	2466577	5/15/1998	04:00:57.77	3.995	7.654
136	45.178	17.863	1.134	34.498	13.303	2333080	2465691	5/15/1998	04:06:58.56	3.870	7.650
137	45.205	17.891	1.111	34.497	13.303	2336919	2466221	5/15/1998	04:12:59.35	3.897	7.653
138	45.224	17.913	1.089	34.494	13.303	2371025	2466294	5/15/1998	04:19:00.14	4.131	7.653
139	45.257	17.937	1.044	34.502	13.303	2345181	2465861	5/15/1998	04:25:00.93	3.953	7.651
140	45.285	17.968	1.008	34.5	13.301	2372030	2466755	5/15/1998	04:31:01.72	4.138	7.655
141	45.305	17.988	0.987	34.5	13.301	2285279	2465932	5/15/1998	04:37:02.51	3.542	7.652
142	45.327	18.02	0.95	34.491	13.302	2344166	2465843	5/15/1998	04:43:44.53	3.946	7.651
143	45.362	18.048	0.933	34.498	13.3	2369962	2466366	5/15/1998	04:49:45.32	4.123	7.653
144	45.381	18.062	0.892	34.502	13.3	2369947	2466500	5/15/1998	04:55:46.11	4.123	7.654
145	45.399	18.088	0.855	34.495	13.299	2322085	2466747	5/15/1998	05:01:46.90	3.795	7.655
146	45.427	18.111	0.882	34.5	13.299	2368270	2466240	5/15/1998	05:07:47.69	4.112	7.653
147	45.446	18.133	0.855	34.497	13.299	2353575	2467488	5/15/1998	05:13:48.48	4.011	7.658
148	45.468	18.154	0.849	34.499	13.3	2350109	2466098	5/15/1998	05:19:49.27	3.987	7.652
149	45.482	18.179	0.817	34.49	13.299	2351218	2465947	5/15/1998	05:25:50.06	3.995	7.652
150	45.501	18.194	0.803	34.493	13.3	2359344	2465720	5/15/1998	05:31:50.85	4.051	7.651
151	45.526	18.21	0.79	34.5	13.298	2349084	2466761	5/15/1998	05:37:51.64	3.980	7.655
152	45.543	18.234	0.749	34.494	13.299	2362851	2466357	5/15/1998	05:43:52.43	4.075	7.653
153	45.561	18.261	0.757	34.488	13.298	2381029	2466728	5/15/1998	05:49:53.22	4.199	7.655
154	45.574	18.266	0.74	34.495	13.298	2353587	2466647	5/15/1998	05:55:54.01	4.011	7.655
155	45.598	18.282	0.741	34.501	13.298	2386931	2466048	5/15/1998	06:01:54.80	4.240	7.652
156	45.612	18.303	0.751	34.496	13.298	2291650	2466400	5/15/1998	06:07:55.59	3.586	7.654
157	45.634	18.327	0.727	34.494	13.299	2371093	2465348	5/15/1998	06:13:56.38	4.131	7.649
158	45.654	18.347	0.769	34.494	13.298	2391363	2465810	5/15/1998	06:19:57.17	4.270	7.651
159	45.672	18.365	0.735	34.493	13.299	2362448	2465915	5/15/1998	06:25:57.96	4.072	7.651
160	45.687	18.377	0.729	34.496	13.298	2338958	2465723	5/15/1998	06:31:58.75	3.911	7.651
161	45.702	18.394	0.726	34.496	13.299	2314425	2465538	5/15/1998	06:37:59.54	3.742	7.650
162	45.72	18.408	0.708	34.498	13.299	2328691	2465559	5/15/1998	06:44:00.33	3.840	7.650
163	45.732	18.429	0.741	34.491	13.298	2379082	2465707	5/15/1998	06:50:01.12	4.186	7.651
164	45.748	18.443	0.719	34.493	13.298	2399845	2465226	5/15/1998	06:56:01.91	4.329	7.648
165	45.762	18.459	0.731	34.491	13.297	2380967	2465836	5/15/1998	07:02:02.70	4.199	7.651
166	45.772	18.47	0.759	34.491	13.297	2390271	2465550	5/15/1998	07:08:03.49	4.263	7.650
167	45.786	18.486	0.777	34.489	13.297	2388876	2465017	5/15/1998	07:14:04.28	4.253	7.648
168	45.802	18.497	0.801	34.492	13.297	2280680	2465085	5/15/1998	07:20:05.07	3.511	7.648
169	45.808	18.5	0.799	34.496	13.296	2359304	2464679	5/15/1998	07:26:05.86	4.050	7.646
170	45.824	18.524	0.801	34.489	13.297	2372525	2464574	5/15/1998	07:32:06.65	4.141	7.646
171	45.835	18.527	0.809	34.496	13.295	2375619	2464652	5/15/1998	07:38:07.44	4.162	7.646
172	45.846	18.549	0.8	34.486	13.295	2380342	2464870	5/15/1998	07:44:08.23	4.195	7.647
173	45.857	18.557	0.816	34.488	13.295	2371967	2465125	5/15/1998	07:50:09.02	4.137	7.648
174	45.867	18.569	0.86	34.487	13.296	2333301	2464295	5/15/1998	07:56:09.81	3.872	7.644
175	45.879	18.589	0.882	34.481	13.295	2351599	2464428	5/15/1998	08:02:10.60	3.997	7.645
176	45.892	18.593	0.895	34.488	13.295	2346469	2463816	5/15/1998	08:08:11.39	3.962	7.642
177	45.903	18.618	0.937	34.477	13.294	2374377	2463877	5/15/1998	08:14:12.18	4.154	7.643
178	45.911	18.616	0.956	34.485	13.295	2356857	2464421	5/15/1998	08:20:12.97	4.034	7.645
179	45.919	18.631	0.966	34.479	13.294	2366693	2464477	5/15/1998	08:26:13.76	4.101	7.645
180	45.931	18.64	0.97	34.482	13.293	2405428	2464468	5/15/1998	08:32:14.55	4.367	7.645
181	45.947	18.645	0.984	34.491	13.293	2400302	2464281	5/15/1998	08:38:15.34	4.332	7.644
182	45.958	18.661	0.997	34.487	13.276	2378810	2464468	5/15/1998	08:44:16.14	4.184	7.645
183	45.952	18.666	1.029	34.478	13.257	2326999	2464612	5/15/1998	08:50:16.93	3.829	7.646
184	45.971	18.673	1.067	34.488	13.27	2367434	2463728	5/15/1998	08:56:17.72	4.106	7.642
185	45.972	18.682	1.095	34.481	13.276	2373371	2464243	5/15/1998	09:02:18.51	4.147	7.644

Record No.	Conductivity (mS/cm)	Temperature (Deg. C)	Pressure (dBar)	Salinity (PSU)	CTD Bat. (Vdc)	D.O. (Integer)	pH (Integer)	Date	Time	D.O. (ml/L)	pH (Value)
186	45.98	18.691	1.115	34.481	13.281	2364539	2464082	5/15/1998	09:08:19.30	4.086	7.644
187	45.985	18.688	1.156	34.487	13.28	2383525	2464173	5/15/1998	09:14:20.09	4.217	7.644
188	45.992	18.687	1.172	34.494	13.282	2380216	2463707	5/15/1998	09:20:20.88	4.194	7.642
189	45.992	18.703	1.202	34.481	13.28	2368968	2464278	5/15/1998	09:26:21.67	4.117	7.644
190	45.992	18.694	1.213	34.488	13.283	2350019	2463640	5/15/1998	09:32:22.46	3.987	7.642
191	45.987	18.694	1.254	34.484	13.28	2354642	2463795	5/15/1998	09:38:23.25	4.018	7.642
192	45.983	18.692	1.282	34.482	13.28	2406127	2463927	5/15/1998	09:44:24.04	4.372	7.643
193	45.976	18.682	1.325	34.484	13.282	2364024	2464092	5/15/1998	09:50:24.83	4.083	7.644
194	45.972	18.674	1.347	34.488	13.283	2385935	2463686	5/15/1998	09:56:25.62	4.233	7.642
195	45.96	18.667	1.324	34.483	13.28	2358993	2464565	5/15/1998	10:02:26.41	4.048	7.646
196	45.952	18.657	1.4	34.485	13.282	2385743	2463581	5/15/1998	10:08:27.20	4.232	7.641
197	45.948	18.648	1.374	34.489	13.28	2337293	2464040	5/15/1998	10:14:27.99	3.899	7.643
198	45.943	18.642	1.397	34.49	13.281	2382243	2464224	5/15/1998	10:20:28.78	4.208	7.644
199	45.935	18.633	1.442	34.491	13.28	2350789	2464025	5/15/1998	10:26:29.57	3.992	7.643
200	45.918	18.616	1.4	34.491	13.281	2383707	2464502	5/15/1998	10:32:30.36	4.218	7.645
201	45.914	18.614	1.461	34.489	13.28	2369711	2464506	5/15/1998	10:38:31.15	4.122	7.645
202	45.907	18.603	1.499	34.492	13.28	2361019	2464312	5/15/1998	10:44:31.94	4.062	7.645
203	45.898	18.597	1.57	34.49	13.28	2404815	2464943	5/15/1998	10:50:32.73	4.363	7.647
204	45.882	18.589	1.586	34.483	13.28	2396909	2464743	5/15/1998	10:56:33.52	4.308	7.646
205	45.878	18.581	1.573	34.486	13.279	2280660	2464190	5/15/1998	11:02:34.31	3.511	7.644
206	45.876	18.576	1.54	34.489	13.279	2391740	2464058	5/15/1998	11:08:35.10	4.273	7.643
207	45.87	18.572	1.58	34.487	13.278	2356241	2464542	5/15/1998	11:14:35.89	4.029	7.646
208	45.871	18.567	1.611	34.492	13.278	2378496	2463580	5/15/1998	11:20:36.68	4.182	7.641
209	45.864	18.572	1.593	34.482	13.278	2395631	2463980	5/15/1998	11:26:37.47	4.300	7.643
210	45.867	18.566	1.643	34.49	13.277	2352619	2464314	5/15/1998	11:32:38.26	4.004	7.645
211	45.868	18.57	1.614	34.487	13.277	2369975	2463766	5/15/1998	11:38:39.05	4.124	7.642
212	45.864	18.565	1.7	34.488	13.276	2379839	2464065	5/15/1998	11:45:21.07	4.191	7.643
213	45.851	18.556	1.707	34.484	13.276	2367463	2464065	5/15/1998	11:51:21.86	4.106	7.643
214	45.832	18.529	1.705	34.492	13.276	2354682	2463791	5/15/1998	11:57:22.65	4.019	7.642
215	45.82	18.523	1.683	34.486	13.276	2378706	2463284	5/15/1998	12:03:23.44	4.184	7.640
216	45.814	18.508	1.696	34.493	13.277	2366231	2463930	5/15/1998	12:09:24.23	4.098	7.643
217	45.798	18.488	1.698	34.497	13.274	2355692	2463649	5/15/1998	12:15:25.02	4.026	7.642
218	45.775	18.473	1.719	34.49	13.274	2346827	2463915	5/15/1998	12:21:25.81	3.965	7.643
219	45.758	18.449	1.779	34.496	13.272	2344638	2465705	5/15/1998	12:27:26.60	3.950	7.651
220	45.737	18.43	1.737	34.494	13.272	2368711	2464033	5/15/1998	12:33:27.39	4.115	7.643
221	45.712	18.403	1.74	34.496	13.273	2380056	2463707	5/15/1998	12:39:28.18	4.193	7.642
222	45.695	18.387	1.74	34.495	13.272	2393889	2463532	5/15/1998	12:45:28.97	4.288	7.641
223	45.677	18.361	1.753	34.501	13.271	2379914	2463815	5/15/1998	12:51:29.76	4.192	7.642
224	45.661	18.348	1.769	34.499	13.27	2355802	2463778	5/15/1998	12:57:30.55	4.026	7.642
225	45.637	18.331	1.736	34.493	13.27	2380692	2463615	5/15/1998	13:03:31.34	4.197	7.642
226	45.625	18.312	1.721	34.498	13.269	2375283	2463711	5/15/1998	13:09:32.13	4.160	7.642
227	45.605	18.305	1.709	34.488	13.269	2332420	2464032	5/15/1998	13:15:32.92	3.866	7.643
228	45.6	18.283	1.718	34.502	13.27	2379168	2463435	5/15/1998	13:21:33.71	4.187	7.641
229	45.594	18.284	1.776	34.496	13.269	2373904	2463396	5/15/1998	13:27:34.50	4.151	7.641
230	45.587	18.272	1.733	34.499	13.27	2389117	2463288	5/15/1998	13:33:35.29	4.255	7.640
231	45.569	18.262	1.717	34.493	13.267	2336928	2464156	5/15/1998	13:39:36.08	3.897	7.644
232	45.566	18.251	1.704	34.5	13.267	2347445	2463202	5/15/1998	13:45:36.87	3.969	7.640
233	45.553	18.236	1.719	34.501	13.267	2364355	2463414	5/15/1998	13:51:37.66	4.085	7.641
234	45.55	18.233	1.674	34.501	13.267	2344025	2463584	5/15/1998	13:57:38.45	3.945	7.641
235	45.533	18.216	1.692	34.502	13.266	2362191	2463667	5/15/1998	14:03:39.24	4.070	7.642
236	45.53	18.213	1.646	34.502	13.267	2383481	2463735	5/15/1998	14:09:40.03	4.216	7.642
237	45.52	18.201	1.668	34.503	13.268	2376804	2463101	5/15/1998	14:15:40.82	4.170	7.639
238	45.509	18.185	1.649	34.507	13.266	2402584	2464023	5/15/1998	14:21:41.61	4.347	7.643
239	45.503	18.184	1.629	34.503	13.266	2353467	2463492	5/15/1998	14:27:42.40	4.010	7.641
240	45.489	18.172	1.598	34.501	13.264	2351016	2463020	5/15/1998	14:33:43.19	3.993	7.639
241	45.482	18.165	1.639	34.501	13.265	2384912	2463441	5/15/1998	14:39:43.98	4.226	7.641
242	45.473	18.152	1.611	34.504	13.263	2363394	2463111	5/15/1998	14:45:44.77	4.078	7.639
243	45.463	18.141	1.592	34.505	13.263	2365024	2463029	5/15/1998	14:51:45.56	4.090	7.639
244	45.453	18.136	1.555	34.501	13.262	2371528	2463597	5/15/1998	14:57:46.35	4.134	7.641
245	45.448	18.13	1.575	34.502	13.262	2352113	2463504	5/15/1998	15:03:47.14	4.001	7.641
246	45.448	18.128	1.579	34.503	13.261	2339784	2463469	5/15/1998	15:09:47.93	3.916	7.641
247	45.442	18.117	1.492	34.507	13.262	2379245	2463490	5/15/1998	15:15:48.72	4.187	7.641
248	45.432	18.104	1.527	34.51	13.261	2383217	2462880	5/15/1998	15:21:49.51	4.214	7.638
249	45.423	18.11	1.499	34.497	13.261	2360587	2463319	5/15/1998	15:27:50.30	4.059	7.640
250	45.42	18.094	1.449	34.508	13.26	2359980	2463330	5/15/1998	15:33:51.09	4.055	7.640
251	45.41	18.091	1.425	34.503	13.259	2363695	2463184	5/15/1998	15:39:51.88	4.080	7.640
252	45.406	18.079	1.45	34.509	13.261	2368615	2463361	5/15/1998	15:45:52.67	4.114	7.640
253	45.399	18.082	1.415	34.501	13.26	2380394	2463643	5/15/1998	15:51:53.46	4.195	7.642
254	45.388	18.077	1.458	34.496	13.259	2324128	2464041	5/15/1998	15:57:54.25	3.809	7.643
255	45.394	18.071	1.451	34.505	13.258	2357274	2464178	5/15/1998	16:03:55.04	4.036	7.644
256	45.391	18.068	1.4	34.505	13.258	2351656	2463736	5/15/1998	16:09:55.83	3.998	7.642
257	45.385	18.058	1.381	34.508	13.258	2381841	2463657	5/15/1998	16:15:56.62	4.205	7.642
258	45.389	18.054	1.4	34.516	13.258	2346587	2464198	5/15/1998	16:21:57.41	3.963	7.644
259	45.386	18.066	1.378	34.503	13.258	2354135	2463708	5/15/1998	16:27:58.20	4.015	7.642
260	45.397	18.068	1.328	34.51	13.258	2381200	2464481	5/15/1998	16:33:58.99	4.201	7.645
261	45.41	18.084	1.345	34.509	13.258	2395788	2463932	5/15/1998	16:39:59.78	4.301	7.643
262	45.414	18.094	1.361	34.503	13.258	2377841	2464211	5/15/1998	16:46:00.57	4.178	7.644
263	45.429	18.104	1.301	34.507	13.259	2358469	2463743	5/15/1998	16:52:01.36	4.045	7.642
264	45.443	18.12	1.315	34.505	13.257	2356930	2465759	5/15/1998	16:58:02.15	4.034	7.651
265	45.458	18.123	1.344	34.517	13.258	2361082	2463896	5/15/1998	17:04:02.94	4.063	7.643
266	45.468	18.141	1.31	34.51	13.258	2390020	2464435	5/15/1998	17:10:03.73	4.261	7.645
267	45.479	18.152	1.308	34.509	13.258	2348005	2464148	5/15/1998	17:16:04.52	3.973	7.644
268	45.492	18.161	1.319	34.513	13.256	2396793	2465141	5/15/1998	17:22:05.31	4.308	7.648
269	45.508	18.183	1.289	34.508	13.258	2381427	2465049	5/15/1998	17:28:06.10	4.202	7.648
270	45.521	18.196	1.339	34.508	13.257	2382892	2464671	5/15/1998	17:34:06.89	4.212	7.646
271	45.533	18.213	1.313	34.504	13.256	2397674	2465097	5/15/1998	17:40:07.68	4.314	7.648
272	45.553	18.23	1.337	34.507	13.258	2402697	2465238	5/15/1998	17:46:08.47	4.348	7.649
273	45.566	18.238	1.322	34.511	13.257	2353153	2465328	5/15/1998	17:52:09.26	4.008	7.649
274	45.582	18.257	1.294	34.509	13.257	2380839	2465578	5/15/1998	17:58:10.05	4.198	7.650
275	45.598	18.272	1.316	34.509	13.256	2394227	2465849	5/15/1998	18:04:10.84	4.290	7.651
276	45.603	18.283	1.355	34.505	13.258	2351650	2465497	5/15/1998	18:10:11.63	3.998	7.650
277	45.62	18.293	1.331	34.51	13.254	2369528	2465711	5/15/1998	18:16:12.42	4.121	7.651
278	45.626	18.304	1.353	34.506	13.258	2397359	2465550	5/15/1998	18:22:13.21	4.312	7.650
279	45.635	18.312	1.321	34.507	13.255	2371123	2466458	5/15/1998	18:28:14.00	4.131	7.654

Record No.	Conductivity (mS/cm)	Temperature (Deg. C)	Pressure (dBar)	Salinity (PSU)	CTD Bat. (Vdc)	D.O. (Integer)	pH (Integer)	Date	Time	D.O. (ml/L)	pH (Value)
280	45.651	18.321	1.353	34.513	13.255	2380264	2466741	5/15/1998	18:34:14.79	4.194	7.655
281	45.657	18.332	1.359	34.509	13.255	2387365	2466233	5/15/1998	18:40:15.58	4.243	7.653
282	45.656	18.336	1.383	34.505	13.253	2391766	2466929	5/15/1998	18:46:57.62	4.273	7.656
283	45.67	18.344	1.353	34.509	13.253	2392285	2466969	5/15/1998	18:52:58.41	4.277	7.656
284	45.669	18.346	1.37	34.507	13.256	2371420	2467163	5/15/1998	18:58:59.20	4.134	7.657
285	45.675	18.351	1.4	34.508	13.254	2364223	2467230	5/15/1998	19:04:59.99	4.084	7.657
286	45.675	18.346	1.415	34.513	13.251	2354463	2466804	5/15/1998	19:11:00.78	4.017	7.655
287	45.677	18.347	1.397	34.513	13.252	2345955	2466627	5/15/1998	19:17:01.57	3.959	7.655
288	45.684	18.358	1.384	34.51	13.254	2385862	2467170	5/15/1998	19:23:02.36	4.233	7.657
289	45.686	18.368	1.418	34.503	13.252	2359116	2466945	5/15/1998	19:29:03.15	4.049	7.656
290	45.698	18.365	1.445	34.516	13.251	2381054	2467458	5/15/1998	19:35:03.94	4.200	7.658
291	45.697	18.369	1.513	34.511	13.25	2375820	2467191	5/15/1998	19:41:04.73	4.164	7.657
292	45.698	18.374	1.507	34.508	13.25	2377280	2467003	5/15/1998	19:47:05.52	4.174	7.656
293	45.706	18.378	1.524	34.512	13.25	2391057	2467266	5/15/1998	19:53:06.31	4.268	7.657
294	45.703	18.376	1.579	34.511	13.249	2362852	2466873	5/15/1998	19:59:07.10	4.075	7.656
295	45.705	18.378	1.563	34.511	13.249	2381681	2467730	5/15/1998	20:05:07.89	4.204	7.659
296	45.708	18.376	1.559	34.515	13.249	2385570	2467100	5/15/1998	20:11:08.68	4.231	7.657
297	45.7	18.375	1.599	34.509	13.248	2337237	2467344	5/15/1998	20:17:09.47	3.899	7.658
298	45.703	18.376	1.558	34.51	13.249	2382983	2467469	5/15/1998	20:23:10.26	4.213	7.658
299	45.702	18.365	1.58	34.519	13.249	2374780	2467039	5/15/1998	20:29:11.05	4.157	7.656
300	45.697	18.371	1.627	34.51	13.248	2370041	2466759	5/15/1998	20:35:11.84	4.124	7.655
301	45.696	18.366	1.691	34.513	13.247	2323110	2467521	5/15/1998	20:41:12.63	3.802	7.658
302	45.688	18.359	1.734	34.512	13.246	2349356	2468039	5/15/1998	20:47:13.42	3.982	7.661
303	45.687	18.351	1.722	34.518	13.247	2382767	2467841	5/15/1998	20:53:14.21	4.211	7.660
304	45.676	18.349	1.759	34.511	13.244	2384210	2468098	5/15/1998	20:59:15.00	4.221	7.661
305	45.661	18.335	1.741	34.509	13.245	2388360	2466741	5/15/1998	21:05:15.79	4.250	7.655
306	45.637	18.31	1.756	34.51	13.243	2369829	2467429	5/15/1998	21:11:16.58	4.123	7.658
307	45.624	18.294	1.759	34.513	13.245	2372489	2467231	5/15/1998	21:17:17.37	4.141	7.657
308	45.616	18.28	1.732	34.518	13.244	2376284	2467547	5/15/1998	21:23:18.16	4.167	7.658
309	45.597	18.259	1.783	34.52	13.241	2370010	2467382	5/15/1998	21:29:18.95	4.124	7.658
310	45.572	18.235	1.846	34.519	13.242	2369035	2467334	5/15/1998	21:35:19.74	4.117	7.658
311	45.56	18.217	1.82	34.523	13.243	2359090	2466974	5/15/1998	21:41:20.53	4.049	7.656
312	45.54	18.213	1.892	34.51	13.24	2373006	2467145	5/15/1998	21:47:21.32	4.144	7.657
313	45.524	18.19	1.88	34.516	13.24	2384965	2468153	5/15/1998	21:53:22.11	4.226	7.661
314	45.51	18.184	1.891	34.508	13.24	2372198	2467057	5/15/1998	21:59:22.90	4.139	7.656
315	45.501	18.163	1.922	34.519	13.24	2367592	2467374	5/15/1998	22:05:23.69	4.107	7.658
316	45.49	18.151	1.893	34.519	13.24	2371961	2467695	5/15/1998	22:11:24.48	4.137	7.659
317	45.482	18.138	1.963	34.524	13.238	2337747	2467876	5/15/1998	22:17:25.27	3.902	7.660
318	45.469	18.124	1.91	34.525	13.239	2319494	2467315	5/15/1998	22:23:26.06	3.777	7.657
319	45.461	18.121	1.931	34.52	13.239	2375343	2467483	5/15/1998	22:29:26.85	4.160	7.658
320	45.448	18.107	1.918	34.52	13.237	2377429	2467054	5/15/1998	22:35:27.64	4.175	7.656
321	45.435	18.1	1.969	34.516	13.238	2376011	2467161	5/15/1998	22:41:28.43	4.165	7.657
322	45.429	18.088	1.956	34.52	13.237	2356935	2467112	5/15/1998	22:47:29.22	4.034	7.657
323	45.423	18.08	2.023	34.523	13.237	2367734	2467518	5/15/1998	22:53:30.01	4.108	7.658
324	45.418	18.073	1.985	34.524	13.237	2379972	2467754	5/15/1998	22:59:30.80	4.192	7.659
325	45.414	18.073	1.998	34.52	13.237	2345571	2467752	5/15/1998	23:05:31.59	3.956	7.659
326	45.407	18.061	1.987	34.525	13.235	2339841	2467434	5/15/1998	23:11:32.38	3.917	7.658
327	45.408	18.071	1.978	34.517	13.236	2359499	2467795	5/15/1998	23:17:33.17	4.052	7.660
328	45.401	18.057	1.996	34.524	13.233	2358925	2467783	5/15/1998	23:23:33.96	4.048	7.660
329	45.405	18.058	1.971	34.526	13.234	2395086	2468229	5/15/1998	23:29:34.75	4.296	7.661
330	45.401	18.05	2.04	34.529	13.235	2365691	2467615	5/15/1998	23:35:35.54	4.094	7.659
331	45.405	18.062	2.014	34.522	13.234	2355304	2467233	5/15/1998	23:41:36.33	4.023	7.657
332	45.407	18.053	1.99	34.532	13.233	2383424	2467011	5/15/1998	23:47:37.12	4.216	7.656
333	45.4	18.056	2.009	34.523	13.232	2383121	2467779	5/15/1998	23:53:37.91	4.214	7.659
334	45.395	18.052	2.015	34.523	13.233	2377891	2467329	5/15/1998	23:59:38.70	4.178	7.658
335	45.405	18.05	1.989	34.533	13.232	2395826	2467853	5/16/1998	00:05:39.49	4.301	7.660
336	45.406	18.057	1.969	34.527	13.231	2373496	2467524	5/16/1998	00:11:40.28	4.148	7.658
337	45.395	18.042	1.985	34.53	13.231	2346109	2467578	5/16/1998	00:17:41.07	3.960	7.659
338	45.394	18.049	1.988	34.524	13.23	2356741	2468195	5/16/1998	00:23:41.86	4.033	7.661
339	45.389	18.031	1.952	34.535	13.231	2372855	2467422	5/16/1998	00:29:42.65	4.143	7.658
340	45.39	18.033	1.957	34.533	13.228	2356792	2467648	5/16/1998	00:35:43.44	4.033	7.659
341	45.386	18.033	1.932	34.531	13.233	2359037	2467677	5/16/1998	00:41:44.23	4.049	7.659
342	45.378	18.029	1.926	34.527	13.229	2357632	2467844	5/16/1998	00:47:45.02	4.039	7.660
343	45.375	18.027	1.923	34.526	13.228	2363040	2467285	5/16/1998	00:53:45.81	4.076	7.657
344	45.371	18.024	1.915	34.526	13.227	2359224	2467800	5/16/1998	00:59:46.60	4.050	7.660
345	45.37	18.022	1.862	34.526	13.231	2355096	2467827	5/16/1998	01:05:47.39	4.021	7.660
346	45.36	18.015	1.816	34.523	13.229	2352383	2467772	5/16/1998	01:11:48.18	4.003	7.659
347	45.351	18.003	1.846	34.527	13.229	2340953	2467358	5/16/1998	01:17:48.97	3.924	7.658
348	45.345	18.002	1.81	34.522	13.229	2367112	2467796	5/16/1998	01:23:49.76	4.104	7.660
349	45.345	17.992	1.778	34.531	13.23	2358870	2467168	5/16/1998	01:29:50.55	4.047	7.657
350	45.337	17.989	1.78	34.526	13.229	2377140	2467209	5/16/1998	01:35:51.34	4.173	7.657
351	45.331	17.982	1.712	34.527	13.229	2375405	2467268	5/16/1998	01:41:52.13	4.161	7.657
352	45.332	17.976	1.71	34.533	13.227	2348207	2467943	5/16/1998	01:48:34.16	3.974	7.660
353	45.329	17.976	1.685	34.53	13.226	2374527	2467638	5/16/1998	01:54:34.95	4.155	7.659
354	45.33	17.98	1.633	34.528	13.227	2349078	2467880	5/16/1998	02:00:35.74	3.980	7.660
355	45.328	17.973	1.631	34.532	13.225	2366638	2467221	5/16/1998	02:06:36.53	4.101	7.657
356	45.327	17.978	1.579	34.527	13.225	2350933	2467135	5/16/1998	02:12:37.32	3.993	7.657
357	45.327	17.981	1.583	34.525	13.226	2350551	2468078	5/16/1998	02:18:38.11	3.990	7.661
358	45.328	17.975	1.532	34.53	13.224	2360349	2467595	5/16/1998	02:24:38.90	4.058	7.659
359	45.32	17.971	1.498	34.527	13.225	2377524	2467360	5/16/1998	02:30:39.69	4.175	7.658
360	45.327	17.971	1.476	34.532	13.224	2362956	2467649	5/16/1998	02:36:40.48	4.075	7.659
361	45.32	17.973	1.422	34.525	13.223	2389833	2467475	5/16/1998	02:42:41.27	4.260	7.658
362	45.323	17.976	1.398	34.526	13.224	2361460	2467332	5/16/1998	02:48:42.06	4.065	7.658
363	45.317	17.969	1.356	34.526	13.222	2354738	2467231	5/16/1998	02:54:42.85	4.019	7.657
364	45.325	17.969	1.28	34.533	13.222	2354665	2467091	5/16/1998	03:00:43.64	4.019	7.657
365	45.327	17.969	1.289	34.535	13.222	2408383	2467583	5/16/1998	03:06:44.43	4.387	7.659
366	45.327	17.974	1.278	34.53	13.221	2367075	2467466	5/16/1998	03:12:45.22	4.104	7.658
367	45.324	17.967	1.248	34.534	13.222	2330680	2467166	5/16/1998	03:18:46.01	3.854	7.657
368	45.325	17.974	1.178	34.529	13.22	2369441	2467372	5/16/1998	03:24:46.80	4.120	7.658
369	45.332	17.973	1.115	34.536	13.22	2334352	2467339	5/16/1998	03:30:47.59	3.879	7.658
370	45.335	17.987	1.101	34.526	13.222	2343750	2467793	5/16/1998	03:36:48.38	3.944	7.660
371	45.338	17.981	1.073	34.534	13.219	2338593	2467577	5/16/1998	03:42:49.17	3.908	7.659
372	45.339	17.98	1.038	34.535	13.22	2297495	2467468	5/16/1998	03:48:49.96	3.626	7.658
373	45.34	17.983	1.022	34.534	13.219	2362710	2467716	5/16/1998	03:54:50.75	4.074	7.659

Record No.	Conductivity (mS/cm)	Temperature (Deg. C)	Pressure (dBar)	Salinity (PSU)	CTD Bat. (Vdc)	D.O. (Integer)	pH (Integer)	Date	Time	D.O. (ml/L)	pH (Value)
374	45.345	17.988	0.97	34.534	13.218	2356859	2467618	5/16/1998	04:00:51.54	4.034	7.659
375	45.345	17.986	0.936	34.536	13.22	2344295	2467594	5/16/1998	04:06:52.33	3.947	7.659
376	45.342	17.987	0.902	34.533	13.219	2359049	2467549	5/16/1998	04:12:53.12	4.049	7.658
377	45.341	17.993	0.858	34.526	13.22	2362960	2467567	5/16/1998	04:18:53.91	4.075	7.659
378	45.344	17.987	0.827	34.535	13.22	2354292	2467652	5/16/1998	04:24:54.70	4.016	7.659
379	45.353	17.994	0.798	34.536	13.217	2346094	2467114	5/16/1998	04:30:55.49	3.960	7.657
380	45.356	18.003	0.769	34.531	13.22	2370973	2468124	5/16/1998	04:36:56.28	4.130	7.661
381	45.367	18.01	0.74	34.534	13.221	2357293	2467836	5/16/1998	04:42:57.07	4.037	7.660
382	45.38	18.032	0.708	34.526	13.221	2345507	2467879	5/16/1998	04:48:57.86	3.956	7.660
383	45.399	18.041	0.655	34.535	13.223	2333597	2468524	5/16/1998	04:54:58.65	3.874	7.663
384	45.421	18.071	0.663	34.528	13.223	2370228	2467806	5/16/1998	05:00:59.44	4.125	7.660
385	45.44	18.086	0.61	34.532	13.222	2391255	2467502	5/16/1998	05:07:00.23	4.270	7.658
386	45.461	18.107	0.572	34.532	13.221	2366862	2467934	5/16/1998	05:13:01.02	4.102	7.660
387	45.48	18.126	0.555	34.532	13.222	2367017	2467180	5/16/1998	05:19:01.81	4.103	7.657
388	45.493	18.149	0.556	34.524	13.22	2330259	2468073	5/16/1998	05:25:02.60	3.851	7.661
389	45.509	18.161	0.526	34.527	13.221	2377135	2467749	5/16/1998	05:31:03.39	4.173	7.659
390	45.527	18.177	0.489	34.529	13.219	2341738	2467318	5/16/1998	05:37:04.18	3.930	7.658
391	45.545	18.192	0.473	34.532	13.22	2375006	2467446	5/16/1998	05:43:04.97	4.158	7.658
392	45.566	18.213	0.444	34.533	13.222	2372313	2467936	5/16/1998	05:49:05.76	4.140	7.660
393	45.585	18.231	0.447	34.534	13.222	2328565	2467610	5/16/1998	05:55:06.55	3.839	7.659
394	45.592	18.243	0.433	34.529	13.227	2375820	2467135	5/16/1998	06:01:07.34	4.164	7.657
395	45.611	18.262	0.416	34.53	13.223	2358893	2467654	5/16/1998	06:07:08.13	4.048	7.659
396	45.623	18.277	0.377	34.527	13.225	2346040	2466958	5/16/1998	06:13:08.92	3.959	7.656
397	45.639	18.284	0.368	34.534	13.225	2372790	2466916	5/16/1998	06:19:09.71	4.143	7.656
398	45.652	18.305	0.371	34.527	13.223	2364436	2467155	5/16/1998	06:25:10.50	4.086	7.657
399	45.67	18.313	0.364	34.537	13.224	2377688	2466795	5/16/1998	06:31:11.29	4.177	7.655
400	45.679	18.333	0.365	34.527	13.222	2357551	2467141	5/16/1998	06:37:12.08	4.038	7.657
401	45.689	18.345	0.343	34.526	13.222	2339971	2466786	5/16/1998	06:43:12.87	3.918	7.655
402	45.704	18.364	0.319	34.522	13.223	2356143	2467253	5/16/1998	06:49:13.66	4.029	7.657
403	45.716	18.36	0.289	34.536	13.224	2358772	2466608	5/16/1998	06:55:14.45	4.047	7.654
404	45.728	18.376	0.292	34.532	13.223	2348538	2466863	5/16/1998	07:01:15.24	3.976	7.656
405	45.739	18.393	0.299	34.527	13.226	2360453	2466802	5/16/1998	07:07:16.03	4.058	7.655
406	45.747	18.4	0.29	34.528	13.221	2365582	2467431	5/16/1998	07:13:16.82	4.093	7.658
407	45.759	18.416	0.289	34.525	13.221	2349223	2466994	5/16/1998	07:19:17.61	3.981	7.656
408	45.767	18.42	0.308	34.528	13.222	2352634	2466620	5/16/1998	07:25:18.40	4.005	7.654
409	45.781	18.438	0.298	34.525	13.222	2383224	2466270	5/16/1998	07:31:19.19	4.215	7.653
410	45.796	18.451	0.342	34.527	13.22	2348780	2466878	5/16/1998	07:37:19.98	3.978	7.656
411	45.807	18.454	0.34	34.534	13.221	2345413	2466815	5/16/1998	07:43:20.77	3.955	7.655
412	45.812	18.472	0.322	34.522	13.222	2363050	2466966	5/16/1998	07:49:21.56	4.076	7.656
413	45.829	18.484	0.296	34.527	13.222	2391920	2466354	5/16/1998	07:55:22.35	4.274	7.653
414	45.838	18.491	0.306	34.528	13.221	2343056	2466144	5/16/1998	08:01:23.14	3.939	7.652
415	45.851	18.5	0.303	34.532	13.222	2362069	2466077	5/16/1998	08:07:23.93	4.069	7.652
416	45.863	18.52	0.354	34.525	13.221	2358005	2465813	5/16/1998	08:13:24.72	4.041	7.651
417	45.876	18.532	0.366	34.526	13.22	2346991	2466243	5/16/1998	08:19:25.51	3.966	7.653
418	45.888	18.54	0.367	34.529	13.22	2374849	2465587	5/16/1998	08:25:26.30	4.157	7.650
419	45.894	18.545	0.368	34.531	13.219	2367514	2465572	5/16/1998	08:31:27.09	4.107	7.650
420	45.905	18.556	0.433	34.53	13.22	2355595	2465302	5/16/1998	08:37:27.88	4.025	7.649
421	45.914	18.572	0.427	34.525	13.221	2362177	2465679	5/16/1998	08:43:28.67	4.070	7.650
422	45.916	18.572	0.407	34.527	13.219	2376817	2465779	5/16/1998	08:50:10.73	4.171	7.651
423	45.928	18.577	0.46	34.533	13.22	2370694	2465513	5/16/1998	08:56:11.52	4.129	7.650
424	45.93	18.588	0.433	34.524	13.218	2364710	2465486	5/16/1998	09:02:12.31	4.087	7.650
425	45.934	18.587	0.466	34.529	13.219	2370880	2465688	5/16/1998	09:08:13.10	4.130	7.650
426	45.946	18.603	0.49	34.526	13.22	2362163	2465688	5/16/1998	09:14:13.89	4.070	7.650
427	45.951	18.607	0.519	34.526	13.217	2377732	2465540	5/16/1998	09:20:14.68	4.177	7.650
428	45.954	18.613	0.542	34.524	13.218	2343442	2465321	5/16/1998	09:26:15.47	3.941	7.649
429	45.958	18.619	0.555	34.522	13.218	2364455	2465740	5/16/1998	09:32:16.26	4.086	7.651
430	45.957	18.615	0.571	34.525	13.217	2345549	2465131	5/16/1998	09:38:17.05	3.956	7.648
431	45.958	18.616	0.619	34.525	13.217	2364135	2465252	5/16/1998	09:44:17.84	4.084	7.649
432	45.965	18.624	0.645	34.524	13.217	2378187	2464878	5/16/1998	09:50:18.63	4.180	7.647
433	45.962	18.615	0.629	34.53	13.216	2367755	2465241	5/16/1998	09:56:19.42	4.108	7.649
434	45.968	18.626	0.661	34.525	13.217	2371058	2465142	5/16/1998	10:02:20.21	4.131	7.648
435	45.971	18.629	0.655	34.525	13.218	2374850	2464974	5/16/1998	10:08:21.00	4.157	7.647
436	45.974	18.636	0.683	34.522	13.215	2370542	2464716	5/16/1998	10:14:21.79	4.127	7.646
437	45.971	18.639	0.709	34.517	13.218	2337076	2464915	5/16/1998	10:20:22.58	3.898	7.647
438	45.977	18.64	0.746	34.521	13.219	2407642	2464544	5/16/1998	10:26:23.37	4.382	7.646
439	45.981	18.64	0.815	34.524	13.215	2364894	2464814	5/16/1998	10:32:24.16	4.089	7.647
440	45.988	18.641	0.789	34.529	13.214	2365434	2464745	5/16/1998	10:38:24.95	4.092	7.646
441	45.98	18.638	0.808	34.525	13.214	2363864	2464677	5/16/1998	10:44:25.74	4.082	7.646
442	45.981	18.646	0.812	34.52	13.215	2355393	2465537	5/16/1998	10:50:26.53	4.024	7.650
443	45.983	18.645	0.865	34.522	13.214	2369408	2464854	5/16/1998	10:56:27.32	4.120	7.647
444	45.975	18.636	0.852	34.522	13.214	2375164	2465230	5/16/1998	11:02:28.11	4.159	7.648
445	45.972	18.63	0.854	34.525	13.213	2419238	2464471	5/16/1998	11:08:28.90	4.462	7.645
446	45.961	18.621	0.885	34.523	13.212	2341615	2464577	5/16/1998	11:14:29.69	3.929	7.646
447	45.954	18.61	0.929	34.527	13.212	2371574	2464745	5/16/1998	11:20:30.48	4.135	7.646
448	45.939	18.6	0.976	34.522	13.212	2386174	2464794	5/16/1998	11:26:31.27	4.235	7.647
449	45.935	18.589	0.992	34.528	13.211	2372143	2464763	5/16/1998	11:32:32.06	4.138	7.646
450	45.924	18.581	1.002	34.525	13.211	2356895	2464913	5/16/1998	11:38:32.85	4.034	7.647
451	45.911	18.572	1.013	34.522	13.21	2405453	2464511	5/16/1998	11:44:33.64	4.367	7.645
452	45.902	18.56	1.028	34.525	13.211	2394661	2464205	5/16/1998	11:50:34.43	4.293	7.644
453	45.889	18.542	1.084	34.529	13.21	2388545	2464097	5/16/1998	11:56:35.22	4.251	7.644
454	45.874	18.531	1.063	34.525	13.21	2369847	2464778	5/16/1998	12:02:36.01	4.123	7.647
455	45.867	18.515	1.023	34.533	13.21	2346747	2463775	5/16/1998	12:08:36.80	3.964	7.642
456	45.853	18.515	1.107	34.521	13.209	2377117	2464732	5/16/1998	12:14:37.59	4.173	7.646
457	45.839	18.499	1.12	34.522	13.209	2345139	2463841	5/16/1998	12:20:38.38	3.953	7.642
458	45.825	18.474	1.143	34.532	13.208	2376179	2464477	5/16/1998	12:26:39.17	4.166	7.645
459	45.81	18.47	1.125	34.522	13.208	2373567	2464374	5/16/1998	12:32:39.96	4.148	7.645
460	45.816	18.465	1.129	34.532	13.206	2380481	2464950	5/16/1998	12:38:40.75	4.196	7.647
461	45.807	18.462	1.137	34.527	13.209	2327573	2464215	5/16/1998	12:44:41.54	3.833	7.644
462	45.797	18.451	1.158	34.527	13.207	2389970	2464029	5/16/1998	12:50:42.33	4.261	7.643
463	45.788	18.435	1.178	34.533	13.206	2379758	2464539	5/16/1998	12:56:43.12	4.191	7.645
464	45.787	18.438	1.186	34.529	13.207	2358934	2463697	5/16/1998	13:02:43.91	4.048	7.642
465	45.781	18.431	1.207	34.531	13.206	2353875	2464250	5/16/1998	13:08:44.70	4.013	7.644
466	45.767	18.424	1.188	34.525	13.206	2370977	2465039	5/16/1998	13:14:45.49	4.130	7.648
467	45.757	18.407	1.183	34.531	13.203	2362247	2465663	5/16/1998	13:20:46.28	4.071	7.650

Record No.	Conductivity (mS/cm)	Temperature (Deg. C)	Pressure (dBar)	Salinity (PSU)	CTD Bat. (Vdc)	D.O. (Integer)	pH (Integer)	Date	Time	D.O. (ml/L)	pH (Value)
468	45.75	18.398	1.229	34.532	13.204	2382850	2463941	5/16/1998	13:26:47.07	4.212	7.643
469	45.739	18.386	1.211	34.533	13.203	2354702	2465103	5/16/1998	13:32:47.86	4.019	7.648
470	45.734	18.389	1.215	34.526	13.203	2358478	2464088	5/16/1998	13:38:48.65	4.045	7.644
471	45.727	18.38	1.242	34.528	13.202	2373397	2464084	5/16/1998	13:44:49.44	4.147	7.644
472	45.719	18.367	1.233	34.532	13.199	2363116	2465939	5/16/1998	13:50:50.23	4.077	7.652
473	45.706	18.367	1.227	34.521	13.2	2378673	2464619	5/16/1998	13:56:51.02	4.183	7.646
474	45.703	18.343	1.21	34.538	13.199	2372531	2463910	5/16/1998	14:02:51.81	4.141	7.643
475	45.685	18.333	1.214	34.532	13.199	2370729	2464530	5/16/1998	14:08:52.60	4.129	7.645
476	45.681	18.316	1.202	34.543	13.198	2346686	2464976	5/16/1998	14:14:53.39	3.964	7.647
477	45.662	18.308	1.228	34.533	13.2	2341954	2464430	5/16/1998	14:20:54.18	3.931	7.645
478	45.657	18.311	1.209	34.527	13.201	2357701	2464421	5/16/1998	14:26:54.97	4.039	7.645
479	45.653	18.302	1.209	34.531	13.199	2335402	2464029	5/16/1998	14:32:55.76	3.886	7.643
480	45.639	18.283	1.193	34.535	13.198	2363415	2465040	5/16/1998	14:38:56.55	4.079	7.648
481	45.632	18.282	1.196	34.53	13.199	2367654	2464068	5/16/1998	14:44:57.34	4.108	7.643
482	45.625	18.273	1.198	34.531	13.199	2361687	2463712	5/16/1998	14:50:58.13	4.067	7.642
483	45.616	18.262	1.192	34.534	13.199	2332234	2464235	5/16/1998	14:56:58.92	3.865	7.644
484	45.606	18.253	1.151	34.532	13.197	2387899	2464733	5/16/1998	15:02:59.71	4.247	7.646
485	45.599	18.241	1.165	34.536	13.198	2358923	2463690	5/16/1998	15:09:00.50	4.048	7.642
486	45.595	18.238	1.168	34.536	13.2	2388218	2464004	5/16/1998	15:15:01.29	4.249	7.643
487	45.583	18.223	1.159	34.538	13.197	2380298	2464683	5/16/1998	15:21:02.08	4.194	7.646
488	45.571	18.22	1.115	34.531	13.197	2386229	2464287	5/16/1998	15:27:02.87	4.235	7.644
489	45.566	18.203	1.143	34.541	13.197	2326244	2464329	5/16/1998	15:33:03.66	3.823	7.645
490	45.556	18.196	1.157	34.538	13.198	2391305	2464642	5/16/1998	15:39:04.45	4.270	7.646
491	45.552	18.193	1.087	34.537	13.196	2367932	2464694	5/16/1998	15:45:05.24	4.110	7.646
492	45.533	18.176	1.061	34.535	13.194	2364999	2464541	5/16/1998	15:51:47.30	4.089	7.646
493	45.526	18.17	1.072	34.534	13.195	2375858	2464794	5/16/1998	15:57:48.09	4.164	7.647
494	45.516	18.152	1.027	34.541	13.194	2348960	2464449	5/16/1998	16:03:48.88	3.979	7.645
495	45.504	18.147	1.062	34.535	13.194	2352109	2464971	5/16/1998	16:09:49.67	4.001	7.647
496	45.498	18.136	1.032	34.539	13.195	2352347	2464998	5/16/1998	16:15:50.46	4.003	7.647
497	45.493	18.136	1.005	34.535	13.194	2339196	2464992	5/16/1998	16:21:51.25	3.912	7.647
498	45.487	18.126	1.015	34.538	13.196	2361574	2464142	5/16/1998	16:27:52.04	4.066	7.644
499	45.482	18.12	1.022	34.539	13.193	2360144	2464436	5/16/1998	16:33:52.83	4.056	7.645
500	45.474	18.108	0.967	34.543	13.194	2337115	2464595	5/16/1998	16:39:53.62	3.898	7.646
501	45.463	18.091	0.964	34.547	13.193	2351100	2464490	5/16/1998	16:45:54.41	3.994	7.645
502	45.451	18.088	0.933	34.54	13.193	2383584	2464778	5/16/1998	16:51:55.20	4.217	7.647
503	45.446	18.074	0.921	34.547	13.192	2361530	2465183	5/16/1998	16:57:55.99	4.066	7.648
504	45.441	18.07	0.908	34.546	13.193	2391573	2464763	5/16/1998	17:03:56.78	4.272	7.646
505	45.448	18.085	0.943	34.54	13.193	2375491	2464601	5/16/1998	17:09:57.57	4.161	7.646
506	45.45	18.089	0.905	34.538	13.194	2389529	2464738	5/16/1998	17:15:58.36	4.258	7.646
507	45.46	18.097	0.91	34.54	13.192	2340969	2464962	5/16/1998	17:21:59.15	3.925	7.647
508	45.477	18.117	0.909	34.537	13.192	2342003	2464992	5/16/1998	17:27:59.94	3.932	7.647
509	45.488	18.132	0.888	34.534	13.192	2372901	2465404	5/16/1998	17:34:00.73	4.144	7.649
510	45.502	18.134	0.892	34.544	13.191	2374499	2465829	5/16/1998	17:40:01.52	4.155	7.651
511	45.518	18.157	0.904	34.539	13.188	2332155	2466200	5/16/1998	17:46:02.31	3.864	7.653
512	45.53	18.167	0.847	34.541	13.19	2345892	2465381	5/16/1998	17:52:03.10	3.958	7.649
513	45.553	18.186	0.888	34.543	13.19	2378091	2465739	5/16/1998	17:58:03.89	4.179	7.651
514	45.57	18.205	0.86	34.542	13.188	2367452	2465820	5/16/1998	18:04:04.68	4.106	7.651
515	45.591	18.23	0.865	34.539	13.188	2339761	2465898	5/16/1998	18:10:05.47	3.916	7.651
516	45.611	18.242	0.853	34.546	13.191	2346266	2466400	5/16/1998	18:16:06.26	3.961	7.654
517	45.623	18.261	0.871	34.54	13.188	2364061	2466960	5/16/1998	18:22:07.05	4.083	7.656
518	45.637	18.28	0.857	34.535	13.186	2372822	2466124	5/16/1998	18:28:07.84	4.143	7.652
519	45.656	18.293	0.844	34.542	13.187	2365685	2466685	5/16/1998	18:34:08.63	4.094	7.655
520	45.67	18.305	0.878	34.543	13.187	2353791	2466438	5/16/1998	18:40:09.42	4.013	7.654
521	45.668	18.312	0.839	34.536	13.184	2386575	2466954	5/16/1998	18:46:10.21	4.238	7.656
522	45.683	18.322	0.833	34.54	13.186	2354987	2466560	5/16/1998	18:52:11.00	4.021	7.654
523	45.692	18.325	0.869	34.544	13.187	2354107	2466625	5/16/1998	18:58:11.79	4.015	7.655
524	45.696	18.336	0.908	34.538	13.189	2341134	2466451	5/16/1998	19:04:12.58	3.926	7.654
525	45.694	18.335	0.875	34.538	13.187	2368882	2466764	5/16/1998	19:10:13.37	4.116	7.655
526	45.697	18.333	0.924	34.542	13.186	2347339	2466919	5/16/1998	19:16:14.16	3.968	7.656
527	45.693	18.337	0.87	34.535	13.186	2378758	2467027	5/16/1998	19:22:14.95	4.184	7.656
528	45.697	18.335	0.918	34.54	13.184	2362681	2467232	5/16/1998	19:28:15.74	4.074	7.657
529	45.694	18.331	0.886	34.542	13.187	2366986	2466913	5/16/1998	19:34:16.53	4.103	7.656
530	45.691	18.324	0.89	34.545	13.185	2360421	2468338	5/16/1998	19:40:17.32	4.058	7.662
531	45.687	18.325	0.894	34.541	13.183	2379600	2468490	5/16/1998	19:46:18.11	4.190	7.663
532	45.693	18.32	0.901	34.549	13.183	2359686	2468207	5/16/1998	19:52:18.90	4.053	7.661
533	45.689	18.33	0.941	34.537	13.185	2397885	2467017	5/16/1998	19:58:19.69	4.315	7.656
534	45.685	18.319	0.949	34.544	13.187	2350642	2466877	5/16/1998	20:04:20.48	3.991	7.656
535	45.679	18.317	0.969	34.54	13.184	2378571	2466798	5/16/1998	20:10:21.27	4.183	7.655
536	45.684	18.317	0.933	34.545	13.183	2346928	2468411	5/16/1998	20:16:22.06	3.965	7.662
537	45.682	18.314	0.962	34.545	13.185	2334539	2467785	5/16/1998	20:22:22.85	3.880	7.660
538	45.682	18.318	0.998	34.542	13.184	2339871	2467012	5/16/1998	20:28:23.64	3.917	7.656
539	45.68	18.317	0.961	34.542	13.185	2362783	2466783	5/16/1998	20:34:24.43	4.074	7.655
540	45.683	18.318	0.974	34.543	13.184	2383029	2467048	5/16/1998	20:40:25.22	4.213	7.656
541	45.681	18.318	1.006	34.541	13.182	2363565	2468321	5/16/1998	20:46:26.01	4.080	7.662
542	45.684	18.316	1.053	34.546	13.185	2369824	2467478	5/16/1998	20:52:26.80	4.123	7.658
543	45.67	18.308	1.047	34.541	13.182	2368282	2469173	5/16/1998	20:58:27.59	4.112	7.666
544	45.666	18.299	1.073	34.545	13.183	2326759	2467904	5/16/1998	21:04:28.38	3.827	7.660
545	45.66	18.295	1.068	34.543	13.182	2342929	2467685	5/16/1998	21:10:29.17	3.938	7.659
546	45.658	18.304	1.076	34.534	13.179	2361774	2467671	5/16/1998	21:16:29.96	4.067	7.659
547	45.653	18.286	1.12	34.544	13.181	2353908	2467763	5/16/1998	21:22:30.75	4.013	7.659
548	45.648	18.276	1.125	34.548	13.179	2337217	2467807	5/16/1998	21:28:31.54	3.899	7.660
549	45.639	18.264	1.127	34.551	13.179	2371271	2467590	5/16/1998	21:34:32.33	4.132	7.659
550	45.632	18.262	1.117	34.547	13.178	2367347	2467603	5/16/1998	21:40:33.12	4.106	7.659
551	45.617	18.25	1.157	34.544	13.178	2352441	2467076	5/16/1998	21:46:33.91	4.003	7.656
552	45.606	18.237	1.171	34.546	13.178	2354748	2467900	5/16/1998	21:52:34.70	4.019	7.660
553	45.592	18.224	1.195	34.545	13.178	2368829	2467686	5/16/1998	21:58:35.49	4.116	7.659
554	45.584	18.214	1.189	34.547	13.176	2384793	2467288	5/16/1998	22:04:36.28	4.225	7.657
555	45.563	18.198	1.21	34.543	13.176	2348787	2467643	5/16/1998	22:10:37.07	3.978	7.659
556	45.556	18.184	1.212	34.548	13.178	2345808	2467217	5/16/1998	22:16:37.86	3.958	7.657
557	45.532	18.165	1.227	34.544	13.176	2363619	2467489	5/16/1998	22:22:38.65	4.080	7.658
558	45.513	18.143	1.246	34.546	13.176	2359755	2467180	5/16/1998	22:28:39.44	4.053	7.657
559	45.491	18.108	1.232	34.557	13.175	2343311	2468087	5/16/1998	22:34:40.23	3.941	7.661
560	45.483	18.103	1.226	34.554	13.174	2342689	2467742	5/16/1998	22:40:41.02	3.936	7.659
561	45.467	18.098	1.279	34.546	13.171	2364423	2467491	5/16/1998	22:46:41.81	4.085	7.658

Record No.	Conductivity (mS/cm)	Temperature (Deg. C)	Pressure (dBar)	Salinity (PSU)	CTD Bat. (Vdc)	D.O. (Integer)	pH (Integer)	Date	Time	D.O. (ml/L)	pH (Value)
562	45.444	18.073	1.286	34.547	13.173	2365753	2467437	5/16/1998	22:53:23.87	4.095	7.658
563	45.422	18.039	1.301	34.557	13.171	2370680	2468064	5/16/1998	22:59:24.66	4.128	7.661
564	45.41	18.037	1.281	34.548	13.171	2372768	2467330	5/16/1998	23:05:25.45	4.143	7.658
565	45.397	18.017	1.311	34.553	13.171	2338758	2467691	5/16/1998	23:11:26.24	3.909	7.659
566	45.388	18.008	1.332	34.554	13.173	2347926	2467937	5/16/1998	23:17:27.03	3.972	7.660
567	45.38	17.998	1.349	34.555	13.172	2348759	2467185	5/16/1998	23:23:27.82	3.978	7.657
568	45.364	17.977	1.334	34.56	13.169	2365185	2467211	5/16/1998	23:29:28.61	4.091	7.657
569	45.358	17.972	1.278	34.558	13.171	2351984	2467960	5/16/1998	23:35:29.40	4.000	7.660
570	45.352	17.962	1.343	34.562	13.172	2337874	2467387	5/16/1998	23:41:30.19	3.903	7.658
571	45.34	17.954	1.382	34.559	13.17	2321696	2467304	5/16/1998	23:47:30.98	3.792	7.657
572	45.322	17.941	1.399	34.554	13.169	2358306	2467359	5/16/1998	23:53:31.77	4.044	7.658
573	45.319	17.939	1.339	34.554	13.17	2337583	2467462	5/16/1998	23:59:32.56	3.901	7.658
574	45.318	17.929	1.312	34.561	13.169	2365470	2467248	5/17/1998	00:05:33.35	4.093	7.657
575	45.312	17.925	1.315	34.559	13.167	2349387	2467050	5/17/1998	00:11:34.14	3.982	7.656
576	45.311	17.916	1.402	34.565	13.168	2353205	2467416	5/17/1998	00:17:34.93	4.008	7.658
577	45.301	17.92	1.411	34.554	13.166	2337473	2467619	5/17/1998	00:23:35.72	3.901	7.659
578	45.3	17.914	1.351	34.559	13.169	2358633	2467290	5/17/1998	00:29:36.51	4.046	7.657
579	45.306	17.919	1.343	34.559	13.167	2341838	2467741	5/17/1998	00:35:37.30	3.930	7.659
580	45.303	17.921	1.378	34.555	13.168	2335597	2467766	5/17/1998	00:41:38.09	3.888	7.659
581	45.306	17.914	1.395	34.564	13.168	2352442	2467056	5/17/1998	00:47:38.88	4.003	7.656
582	45.298	17.92	1.357	34.551	13.167	2339605	2467423	5/17/1998	00:53:39.67	3.915	7.658
583	45.304	17.916	1.302	34.56	13.172	2325629	2468335	5/17/1998	00:59:40.46	3.819	7.662
584	45.292	17.908	1.339	34.556	13.171	2375801	2467323	5/17/1998	01:05:41.25	4.164	7.658
585	45.291	17.901	1.371	34.561	13.171	2393714	2467936	5/17/1998	01:11:42.04	4.287	7.660
586	45.286	17.897	1.386	34.56	13.17	2344911	2467390	5/17/1998	01:17:42.83	3.952	7.658
587	45.277	17.892	1.328	34.557	13.171	2340091	2467983	5/17/1998	01:23:43.62	3.918	7.660
588	45.27	17.888	1.298	34.555	13.171	2324607	2467197	5/17/1998	01:29:44.41	3.812	7.657
589	45.256	17.871	1.286	34.557	13.17	2354488	2467486	5/17/1998	01:35:45.20	4.017	7.658
590	45.255	17.86	1.32	34.565	13.171	2334609	2466970	5/17/1998	01:41:45.99	3.881	7.656
591	45.249	17.855	1.255	34.564	13.168	2341522	2467301	5/17/1998	01:47:46.78	3.928	7.657
592	45.239	17.851	1.241	34.559	13.169	2357362	2467528	5/17/1998	01:53:47.57	4.037	7.658
593	45.233	17.838	1.227	34.565	13.168	2354461	2466798	5/17/1998	01:59:48.36	4.017	7.655
594	45.227	17.836	1.251	34.562	13.169	2346498	2466464	5/17/1998	02:05:49.15	3.962	7.654
595	45.223	17.818	1.228	34.574	13.169	2329462	2467108	5/17/1998	02:11:49.94	3.846	7.657
596	45.219	17.818	1.168	34.57	13.169	2303440	2467571	5/17/1998	02:17:50.73	3.667	7.659
597	45.215	17.818	1.099	34.567	13.168	2348828	2467607	5/17/1998	02:23:51.52	3.978	7.659
598	45.211	17.813	1.124	34.567	13.167	2315842	2467344	5/17/1998	02:29:52.31	3.752	7.658
599	45.207	17.811	1.113	34.566	13.168	2359304	2466972	5/17/1998	02:35:53.10	4.050	7.656
600	45.204	17.807	1.139	34.567	13.168	2341558	2467290	5/17/1998	02:41:53.89	3.929	7.657
601	45.197	17.797	1.066	34.569	13.166	2339620	2467203	5/17/1998	02:47:54.68	3.915	7.657
602	45.194	17.789	1.033	34.574	13.166	2336496	2467142	5/17/1998	02:53:55.47	3.894	7.657
603	45.197	17.805	1.031	34.562	13.167	2329092	2467169	5/17/1998	02:59:56.26	3.843	7.657
604	45.199	17.806	1.029	34.563	13.165	2345839	2466527	5/17/1998	03:05:57.05	3.958	7.654
605	45.202	17.804	0.98	34.568	13.166	2343813	2467411	5/17/1998	03:11:57.84	3.944	7.658
606	45.197	17.798	0.872	34.569	13.165	2330224	2467036	5/17/1998	03:17:58.63	3.851	7.656
607	45.2	17.804	0.878	34.567	13.164	2355436	2467817	5/17/1998	03:23:59.42	4.024	7.660
608	45.197	17.791	0.884	34.574	13.165	2361804	2467743	5/17/1998	03:30:00.21	4.068	7.659
609	45.202	17.813	0.897	34.56	13.165	2365687	2467669	5/17/1998	03:36:01.00	4.094	7.659
610	45.205	17.797	0.794	34.576	13.166	2321636	2467781	5/17/1998	03:42:01.79	3.792	7.660
611	45.209	17.807	0.795	34.571	13.165	2325346	2467497	5/17/1998	03:48:02.58	3.817	7.658
612	45.208	17.809	0.752	34.569	13.164	2359005	2467658	5/17/1998	03:54:03.37	4.048	7.659
613	45.216	17.817	0.768	34.569	13.164	2343460	2466552	5/17/1998	04:00:04.16	3.942	7.654
614	45.227	17.827	0.71	34.57	13.163	2353426	2467467	5/17/1998	04:06:04.95	4.010	7.658
615	45.235	17.836	0.678	34.569	13.164	2354205	2467116	5/17/1998	04:12:05.74	4.015	7.657
616	45.238	17.832	0.63	34.574	13.164	2310477	2467348	5/17/1998	04:18:06.53	3.715	7.658
617	45.25	17.858	0.668	34.563	13.164	2357586	2467347	5/17/1998	04:24:07.32	4.039	7.658
618	45.256	17.863	0.643	34.564	13.163	2326316	2467019	5/17/1998	04:30:08.11	3.824	7.656
619	45.276	17.877	0.591	34.569	13.164	2348954	2467217	5/17/1998	04:36:08.90	3.979	7.657
620	45.286	17.89	0.51	34.567	13.164	2359153	2466636	5/17/1998	04:42:09.69	4.049	7.655
621	45.285	17.889	0.474	34.567	13.163	2338852	2467149	5/17/1998	04:48:10.48	3.910	7.657
622	45.296	17.897	0.477	34.569	13.162	2306267	2467817	5/17/1998	04:54:11.27	3.686	7.660
623	45.307	17.908	0.463	34.569	13.164	2346058	2467430	5/17/1998	05:00:12.06	3.959	7.658
624	45.323	17.924	0.391	34.569	13.164	2355039	2467178	5/17/1998	05:06:12.85	4.021	7.657
625	45.322	17.934	0.395	34.56	13.162	2359708	2467231	5/17/1998	05:12:13.64	4.053	7.657
626	45.34	17.944	0.344	34.567	13.163	2348177	2467303	5/17/1998	05:18:14.43	3.974	7.657
627	45.352	17.952	0.345	34.57	13.163	2338359	2467454	5/17/1998	05:24:15.22	3.907	7.658
628	45.365	17.973	0.335	34.564	13.163	2335940	2467496	5/17/1998	05:30:16.01	3.890	7.658
629	45.373	17.973	0.273	34.571	13.164	2331284	2467326	5/17/1998	05:36:16.80	3.858	7.658
630	45.38	17.984	0.24	34.567	13.163	2322278	2467280	5/17/1998	05:42:17.59	3.796	7.657
631	45.398	18.004	0.211	34.566	13.164	2350069	2466876	5/17/1998	05:48:18.38	3.987	7.656

Blank Test #2 Sensor Data

Record No.	Conductivity (mS/cm)	Temperature (Deg. C)	Pressure (dBar)	Salinity (PSU)	CTD Bat. (Vdc)	D.O. (Integer)	pH (Integer)	Date	Time	D.O. (ml/L)	pH (Value)
1	46.202	19.133	1.108	34.299	13.16	2390314	2440004	5/21/1998	13:38:51.25	4.263	7.539
2	46.278	19.098	1.076	34.39	13.167	2522865	2451441	5/21/1998	13:45:33.26	5.173	7.589
3	46.316	19.068	1.072	34.448	13.169	2340983	2454720	5/21/1998	13:51:34.06	3.925	7.603
4	46.337	19.061	1.105	34.471	13.172	2509529	2457809	5/21/1998	13:57:34.86	5.081	7.616
5	46.353	19.032	1.159	34.508	13.152	2501876	2458357	5/21/1998	14:03:35.66	5.029	7.619
6	46.359	19.024	1.187	34.52	13.162	2435298	2460954	5/21/1998	14:09:36.46	4.572	7.630
7	46.366	19.012	1.199	34.537	13.163	2427763	2460922	5/21/1998	14:15:37.26	4.520	7.630
8	46.363	19.001	1.208	34.543	13.163	2400872	2461056	5/21/1998	14:21:38.06	4.336	7.630
9	46.358	18.984	1.243	34.553	13.163	2361794	2461934	5/21/1998	14:27:38.86	4.067	7.634
10	46.353	18.964	1.269	34.565	13.162	2458406	2463035	5/21/1998	14:33:39.66	4.730	7.639
11	46.343	18.945	1.304	34.572	13.161	2365812	2463574	5/21/1998	14:39:40.46	4.095	7.641
12	46.334	18.937	1.328	34.571	13.16	2553596	2464094	5/21/1998	14:45:41.26	5.384	7.644
13	46.326	18.932	1.334	34.569	13.16	2584932	2464757	5/21/1998	14:51:42.06	5.599	7.646
14	46.312	18.904	1.444	34.581	13.159	2424556	2465466	5/21/1998	14:57:42.86	4.498	7.649
15	46.281	18.871	1.468	34.582	13.158	2459465	2466503	5/21/1998	15:03:43.66	4.738	7.654
16	46.243	18.838	1.51	34.579	13.159	2454382	2466498	5/21/1998	15:09:44.46	4.703	7.654
17	46.216	18.801	1.53	34.587	13.138	2423580	2466276	5/21/1998	15:15:45.26	4.491	7.653

Record No.	Conductivity (mS/cm)	Temperature (Deg. C)	Pressure (dBar)	Salinity (PSU)	CTD Bat. (Vdc)	D.O. (Integer)	pH (Integer)	Date	Time	D.O. (ml/L)	pH (Value)
18	46.184	18.77	1.512	34.586	13.148	2373287	2467426	5/21/1998	15:21:46.06	4.146	7.658
19	46.158	18.743	1.589	34.586	13.149	2507339	2467756	5/21/1998	15:27:46.86	5.066	7.659
20	46.132	18.708	1.619	34.594	13.15	2505078	2467849	5/21/1998	15:33:47.66	5.051	7.660
21	46.097	18.678	1.619	34.589	13.15	2515458	2467839	5/21/1998	15:39:48.46	5.122	7.660
22	46.072	18.646	1.66	34.596	13.148	2493683	2468153	5/21/1998	15:45:49.26	4.973	7.661
23	46.037	18.618	1.704	34.589	13.148	2533075	2468413	5/21/1998	15:51:50.06	5.243	7.662
24	46.006	18.582	1.735	34.593	13.146	2478840	2469294	5/21/1998	15:57:50.86	4.871	7.666
25	45.967	18.532	1.812	34.602	13.146	2561193	2468621	5/21/1998	16:03:51.66	5.436	7.663
26	45.927	18.502	1.803	34.594	13.146	2552714	2469184	5/21/1998	16:09:52.46	5.378	7.666
27	45.888	18.46	1.839	34.597	13.143	2355165	2470047	5/21/1998	16:15:53.26	4.022	7.669
28	45.854	18.426	1.869	34.597	13.143	2525326	2470359	5/21/1998	16:21:54.06	5.190	7.671
29	45.817	18.388	1.904	34.597	13.146	2458766	2469934	5/21/1998	16:27:54.86	4.733	7.669
30	45.78	18.352	1.956	34.596	13.142	2470958	2470148	5/21/1998	16:33:55.66	4.817	7.670
31	45.746	18.319	1.974	34.595	13.141	2374208	2470550	5/21/1998	16:39:56.46	4.153	7.671
32	45.712	18.289	2.009	34.591	13.14	2437755	2471185	5/21/1998	16:45:57.26	4.589	7.674
33	45.68	18.248	2.023	34.599	13.139	2431687	2470966	5/21/1998	16:51:58.06	4.547	7.673
34	45.645	18.207	2.044	34.604	13.14	2558848	2470882	5/21/1998	16:57:58.86	5.420	7.673
35	45.612	18.179	2.102	34.599	13.136	2413532	2470847	5/21/1998	17:03:59.66	4.423	7.673
36	45.579	18.148	2.085	34.598	13.135	2572176	2470840	5/21/1998	17:10:00.46	5.511	7.673
37	45.549	18.109	2.135	34.605	13.137	2480318	2470963	5/21/1998	17:16:01.26	4.881	7.673
38	45.514	18.078	2.167	34.602	13.135	2536597	2471746	5/21/1998	17:22:02.06	5.267	7.677
39	45.478	18.036	2.189	34.606	13.135	2505750	2471657	5/21/1998	17:28:02.86	5.055	7.676
40	45.442	17.985	2.199	34.618	13.133	2500701	2471833	5/21/1998	17:34:03.66	5.021	7.677
41	45.4	17.956	2.21	34.608	13.131	2525424	2472433	5/21/1998	17:40:04.46	5.190	7.680
42	45.363	17.912	2.26	34.613	13.13	2550208	2472446	5/21/1998	17:46:05.26	5.361	7.680
43	45.327	17.876	2.297	34.613	13.129	2506076	2472325	5/21/1998	17:52:06.06	5.058	7.679
44	45.301	17.852	2.283	34.611	13.129	2418967	2472158	5/21/1998	17:58:06.86	4.460	7.678
45	45.273	17.824	2.272	34.612	13.128	2471378	2472321	5/21/1998	18:04:07.66	4.820	7.679
46	45.246	17.786	2.274	34.621	13.127	2366864	2473064	5/21/1998	18:10:08.46	4.102	7.682
47	45.22	17.77	2.274	34.612	13.127	2485840	2472505	5/21/1998	18:16:09.26	4.919	7.680
48	45.197	17.742	2.307	34.615	13.125	2512483	2472953	5/21/1998	18:22:10.06	5.102	7.682
49	45.164	17.707	2.303	34.618	13.125	2517881	2473129	5/21/1998	18:28:10.86	5.139	7.683
50	45.143	17.691	2.285	34.612	13.124	2461695	2473022	5/21/1998	18:34:11.66	4.753	7.682
51	45.112	17.669	2.343	34.605	13.123	2521923	2473058	5/21/1998	18:40:12.46	5.166	7.682
52	45.091	17.631	2.329	34.619	13.123	2555670	2473504	5/21/1998	18:46:13.26	5.398	7.684
53	45.065	17.619	2.324	34.607	13.122	2530853	2473616	5/21/1998	18:52:14.06	5.228	7.685
54	45.037	17.581	2.304	34.615	13.123	2527753	2473714	5/21/1998	18:58:14.86	5.206	7.685
55	45.012	17.548	2.278	34.622	13.122	2520220	2474142	5/21/1998	19:04:15.66	5.155	7.687
56	44.988	17.534	2.286	34.614	13.122	2488670	2474554	5/21/1998	19:10:16.46	4.938	7.689
57	44.974	17.518	2.273	34.615	13.12	2340159	2473935	5/21/1998	19:16:17.26	3.919	7.686
58	44.958	17.492	2.253	34.624	13.12	2505343	2474372	5/21/1998	19:22:18.06	5.053	7.688
59	44.934	17.483	2.247	34.61	13.124	2499414	2474364	5/21/1998	19:28:18.86	5.012	7.688
60	44.923	17.458	2.259	34.623	13.12	2484125	2474709	5/21/1998	19:34:19.66	4.907	7.689
61	44.911	17.449	2.206	34.62	13.12	2463238	2474635	5/21/1998	19:40:20.46	4.764	7.689
62	44.899	17.426	2.177	34.629	13.119	2382057	2474805	5/21/1998	19:46:21.26	4.207	7.690
63	44.885	17.418	2.161	34.624	13.118	2550609	2474660	5/21/1998	19:52:22.06	5.363	7.689
64	44.864	17.402	2.125	34.619	13.119	2452850	2475328	5/21/1998	19:58:22.86	4.692	7.692
65	44.852	17.389	2.079	34.621	13.118	2539657	2474369	5/21/1998	20:04:23.66	5.288	7.688
66	44.845	17.372	2.096	34.629	13.116	2505340	2474789	5/21/1998	20:10:24.46	5.053	7.690
67	44.826	17.357	2.065	34.625	13.118	2483477	2475315	5/21/1998	20:16:25.26	4.903	7.692
68	44.816	17.358	2.054	34.615	13.117	2546740	2475066	5/21/1998	20:22:26.06	5.337	7.691
69	44.814	17.334	2.003	34.634	13.117	2521575	2475101	5/21/1998	20:28:26.86	5.164	7.691
70	44.796	17.329	1.99	34.623	13.116	2537269	2474887	5/21/1998	20:34:27.66	5.272	7.690
71	44.792	17.321	1.957	34.627	13.113	2514934	2475563	5/21/1998	20:40:28.46	5.118	7.693
72	44.784	17.304	1.888	34.634	13.114	2527107	2475467	5/21/1998	20:47:10.46	5.202	7.693
73	44.773	17.298	1.858	34.63	13.113	2535439	2475272	5/21/1998	20:53:11.26	5.259	7.692
74	44.769	17.301	1.835	34.624	13.111	2491451	2475189	5/21/1998	20:59:12.06	4.957	7.692
75	44.764	17.286	1.795	34.632	13.112	2478345	2476044	5/21/1998	21:05:12.86	4.867	7.695
76	44.747	17.28	1.764	34.623	13.111	2419311	2475569	5/21/1998	21:11:13.66	4.462	7.693
77	44.751	17.269	1.703	34.636	13.109	2489444	2475393	5/21/1998	21:17:14.46	4.944	7.692
78	44.753	17.271	1.71	34.636	13.111	2503768	2476429	5/21/1998	21:23:15.26	5.042	7.697
79	44.752	17.282	1.671	34.625	13.112	2512456	2476399	5/21/1998	21:29:16.06	5.101	7.697
80	44.761	17.285	1.659	34.63	13.11	2506785	2476267	5/21/1998	21:35:16.86	5.063	7.696
81	44.761	17.285	1.563	34.631	13.111	2457003	2475595	5/21/1998	21:41:17.66	4.721	7.693
82	44.767	17.284	1.527	34.637	13.109	2557588	2476434	5/21/1998	21:47:18.46	5.411	7.697
83	44.776	17.3	1.502	34.63	13.109	2509352	2476291	5/21/1998	21:53:19.26	5.080	7.696
84	44.786	17.308	1.449	34.633	13.108	2466104	2476058	5/21/1998	21:59:20.06	4.783	7.695
85	44.791	17.313	1.413	34.633	13.108	2555568	2476098	5/21/1998	22:05:20.86	5.397	7.695
86	44.8	17.335	1.413	34.621	13.108	2519069	2476377	5/21/1998	22:11:21.66	5.147	7.697
87	44.815	17.341	1.374	34.629	13.107	2476979	2476875	5/21/1998	22:17:22.46	4.858	7.699
88	44.834	17.351	1.333	34.637	13.108	2453701	2476864	5/21/1998	22:23:23.26	4.698	7.699
89	44.847	17.377	1.312	34.627	13.108	2508059	2476798	5/21/1998	22:29:24.06	5.071	7.698
90	44.867	17.395	1.276	34.628	13.107	2477922	2476404	5/21/1998	22:35:24.86	4.864	7.697
91	44.871	17.4	1.244	34.627	13.107	2466918	2476771	5/21/1998	22:41:25.66	4.789	7.698
92	44.876	17.406	1.175	34.627	13.108	2458859	2477017	5/21/1998	22:47:26.46	4.734	7.699
93	44.889	17.42	1.137	34.626	13.107	2423035	2476877	5/21/1998	22:53:27.26	4.488	7.699
94	44.887	17.412	1.077	34.63	13.107	2477639	2477159	5/21/1998	22:59:28.06	4.862	7.700
95	44.893	17.408	1.092	34.64	13.107	2463486	2477276	5/21/1998	23:05:28.86	4.765	7.701
96	44.906	17.428	1.052	34.633	13.108	2437951	2476897	5/21/1998	23:11:29.66	4.590	7.699
97	44.912	17.442	1.045	34.627	13.104	2564190	2477004	5/21/1998	23:17:30.46	5.456	7.699
98	44.921	17.451	0.969	34.627	13.105	2505644	2477244	5/21/1998	23:23:31.26	5.055	7.700
99	44.928	17.46	0.961	34.625	13.104	2519770	2476920	5/21/1998	23:29:32.06	5.152	7.699
100	44.939	17.466	0.902	34.63	13.106	2492289	2477066	5/21/1998	23:35:32.86	4.963	7.700
101	44.944	17.481	0.894	34.622	13.107	2474222	2477496	5/21/1998	23:41:33.66	4.839	7.701
102	44.958	17.475	0.867	34.639	13.103	2514833	2476933	5/21/1998	23:47:34.46	5.118	7.699
103	44.977	17.498	0.813	34.635	13.1	2447485	2478166	5/21/1998	23:53:35.26	4.656	7.704
104	45.006	17.533	0.81	34.63	13.1	2394625	2477179	5/21/1998	23:59:36.06	4.293	7.700
105	45.017	17.543	0.778	34.631	13.103	2441267	2476859	5/22/1998	00:05:36.86	4.613	7.699
106	45.057	17.586	0.803	34.629	13.103	2471410	2476729	5/22/1998	00:11:37.66	4.820	7.698
107	45.096	17.624	0.778	34.63	13.103	2515227	2477467	5/22/1998	00:17:38.46	5.120	7.701
108	45.129	17.666	0.731	34.623	13.103	2516008	2477202	5/22/1998	00:23:39.26	5.126	7.700
109	45.172	17.703	0.722	34.628	13.101	2461183	2477837	5/22/1998	00:29:40.06	4.750	7.703
110	45.214	17.742	0.717	34.631	13.103	2439726	2477267	5/22/1998	00:35:40.86	4.602	7.700
111	45.245	17.783	0.723	34.623	13.103	2519799	2477347	5/22/1998	00:41:41.66	5.152	7.701

Record No.	Conductivity (mS/cm)	Temperature (Deg. C)	Pressure (dBar)	Salinity (PSU)	CTD Bat. (Vdc)	D.O. (Integer)	pH (Integer)	Date	Time	D.O. (ml/L)	pH (Value)
112	45.278	17.814	0.702	34.625	13.102	2550837	2477708	5/22/1998	00:47:42.46	5.365	7.702
113	45.313	17.844	0.695	34.629	13.105	2519264	2476562	5/22/1998	00:53:43.26	5.148	7.697
114	45.349	17.886	0.675	34.625	13.102	2427305	2477508	5/22/1998	00:59:44.06	4.517	7.702
115	45.381	17.92	0.666	34.623	13.106	2510104	2477272	5/22/1998	01:05:44.86	5.085	7.701
116	45.409	17.948	0.706	34.623	13.106	2489018	2477992	5/22/1998	01:11:45.66	4.941	7.704
117	45.441	17.989	0.702	34.616	13.107	2559590	2477596	5/22/1998	01:17:46.46	5.425	7.702
118	45.474	18.014	0.676	34.622	13.106	2449186	2477557	5/22/1998	01:23:47.26	4.667	7.702
119	45.497	18.04	0.674	34.62	13.106	2562210	2477342	5/22/1998	01:29:48.06	5.443	7.701
120	45.529	18.062	0.66	34.629	13.106	2526724	2477193	5/22/1998	01:35:48.86	5.199	7.700
121	45.545	18.097	0.685	34.613	13.106	2543469	2477368	5/22/1998	01:41:49.66	5.314	7.701
122	45.573	18.105	0.706	34.629	13.106	2360954	2477673	5/22/1998	01:47:50.46	4.062	7.702
123	45.591	18.129	0.705	34.624	13.104	2533349	2477321	5/22/1998	01:53:51.26	5.245	7.701
124	45.608	18.145	0.715	34.626	13.104	2520575	2477208	5/22/1998	01:59:52.06	5.157	7.700
125	45.621	18.173	0.708	34.613	13.105	2329882	2477674	5/22/1998	02:05:52.86	3.848	7.702
126	45.641	18.176	0.722	34.627	13.104	2547123	2477206	5/22/1998	02:11:53.66	5.339	7.700
127	45.653	18.197	0.763	34.62	13.106	2523985	2477146	5/22/1998	02:17:54.46	5.181	7.700
128	45.66	18.208	0.761	34.616	13.104	2510639	2477250	5/22/1998	02:23:55.26	5.089	7.700
129	45.672	18.225	0.781	34.612	13.104	2556839	2476997	5/22/1998	02:29:56.06	5.406	7.699
130	45.688	18.24	0.798	34.613	13.102	2555538	2477086	5/22/1998	02:35:56.86	5.397	7.700
131	45.697	18.247	0.802	34.615	13.103	2577033	2477383	5/22/1998	02:41:57.66	5.545	7.701
132	45.713	18.261	0.826	34.616	13.104	2538299	2477239	5/22/1998	02:47:58.46	5.279	7.700
133	45.724	18.259	0.866	34.628	13.104	2559382	2477180	5/22/1998	02:53:59.26	5.423	7.700
134	45.738	18.279	0.873	34.623	13.104	2520177	2476853	5/22/1998	03:00:00.06	5.154	7.699
135	45.746	18.298	0.911	34.613	13.103	2462069	2477108	5/22/1998	03:06:00.86	4.756	7.700
136	45.758	18.308	0.906	34.615	13.102	2546888	2476971	5/22/1998	03:12:01.66	5.338	7.699
137	45.77	18.319	0.942	34.615	13.103	2531091	2476808	5/22/1998	03:18:02.46	5.229	7.699
138	45.781	18.33	0.988	34.616	13.101	2552020	2477715	5/22/1998	03:24:03.26	5.373	7.702
139	45.786	18.337	1.017	34.614	13.101	2564959	2477456	5/22/1998	03:30:04.06	5.462	7.701
140	45.798	18.344	1.04	34.619	13.101	2478992	2476837	5/22/1998	03:36:04.86	4.872	7.699
141	45.809	18.358	1.042	34.616	13.101	2531656	2476966	5/22/1998	03:42:05.66	5.233	7.699
142	45.813	18.365	1.081	34.613	13.1	2558407	2477173	5/22/1998	03:48:47.68	5.417	7.700
143	45.824	18.372	1.12	34.617	13.1	2531641	2477906	5/22/1998	03:54:48.48	5.233	7.703
144	45.825	18.376	1.145	34.614	13.1	2540305	2477434	5/22/1998	04:00:49.28	5.293	7.701
145	45.824	18.369	1.168	34.619	13.099	2476107	2477134	5/22/1998	04:06:50.08	4.852	7.700
146	45.808	18.357	1.198	34.616	13.1	2542306	2476991	5/22/1998	04:12:50.88	5.306	7.699
147	45.796	18.346	1.243	34.615	13.098	2491920	2477085	5/22/1998	04:18:51.68	4.960	7.700
148	45.777	18.319	1.283	34.621	13.097	2559809	2477640	5/22/1998	04:24:52.48	5.426	7.702
149	45.753	18.304	1.283	34.614	13.097	2535834	2476651	5/22/1998	04:30:53.28	5.262	7.698
150	45.738	18.286	1.306	34.616	13.097	2546808	2476655	5/22/1998	04:36:54.08	5.337	7.698
151	45.722	18.257	1.345	34.628	13.095	2468557	2477490	5/22/1998	04:42:54.88	4.800	7.701
152	45.701	18.251	1.383	34.614	13.096	2528798	2476453	5/22/1998	04:48:55.68	5.214	7.697
153	45.671	18.217	1.396	34.617	13.095	2517556	2477030	5/22/1998	04:54:56.48	5.136	7.699
154	45.648	18.191	1.405	34.62	13.095	2519308	2477160	5/22/1998	05:00:57.28	5.148	7.700
155	45.627	18.166	1.428	34.623	13.094	2555662	2477278	5/22/1998	05:06:58.08	5.398	7.701
156	45.596	18.152	1.425	34.61	13.093	2513395	2476905	5/22/1998	05:12:58.88	5.108	7.699
157	45.577	18.116	1.464	34.623	13.093	2521306	2476796	5/22/1998	05:18:59.68	5.162	7.698
158	45.558	18.105	1.513	34.616	13.092	2555370	2477149	5/22/1998	05:25:00.48	5.396	7.700
159	45.542	18.092	1.526	34.614	13.093	2553861	2476514	5/22/1998	05:31:01.28	5.386	7.697
160	45.537	18.083	1.524	34.617	13.093	2550637	2476525	5/22/1998	05:37:02.08	5.363	7.697
161	45.524	18.069	1.559	34.618	13.092	2541907	2476470	5/22/1998	05:43:02.88	5.304	7.697
162	45.508	18.054	1.615	34.617	13.091	2523072	2477189	5/22/1998	05:49:03.68	5.174	7.700
163	45.472	18.024	1.665	34.612	13.091	2556613	2477205	5/22/1998	05:55:04.48	5.404	7.700
164	45.458	17.994	1.638	34.625	13.09	2484451	2476845	5/22/1998	06:01:05.28	4.909	7.699
165	45.432	17.967	1.667	34.625	13.089	2464945	2477186	5/22/1998	06:07:06.08	4.775	7.700
166	45.407	17.939	1.632	34.628	13.088	2531457	2476656	5/22/1998	06:13:06.88	5.232	7.698
167	45.386	17.918	1.659	34.628	13.088	2505329	2477277	5/22/1998	06:19:07.68	5.053	7.701
168	45.369	17.909	1.695	34.621	13.089	2498060	2477641	5/22/1998	06:25:08.48	5.003	7.702
169	45.348	17.876	1.674	34.631	13.089	2555347	2476938	5/22/1998	06:31:09.28	5.396	7.699
170	45.313	17.843	1.705	34.629	13.087	2538492	2476915	5/22/1998	06:37:10.08	5.280	7.699
171	45.281	17.812	1.735	34.629	13.086	2542194	2476964	5/22/1998	06:43:10.88	5.306	7.699
172	45.25	17.783	1.751	34.626	13.085	2376488	2477291	5/22/1998	06:49:11.68	4.168	7.701
173	45.209	17.716	1.712	34.649	13.085	2513666	2477088	5/22/1998	06:55:12.48	5.110	7.700
174	45.166	17.693	1.717	34.632	13.085	2480147	2476989	5/22/1998	07:01:13.28	4.880	7.699
175	45.13	17.66	1.679	34.628	13.084	2557294	2476859	5/22/1998	07:07:14.08	5.409	7.699
176	45.098	17.62	1.699	34.635	13.083	2529115	2477376	5/22/1998	07:13:14.88	5.216	7.701
177	45.057	17.587	1.684	34.628	13.082	2532466	2477867	5/22/1998	07:19:15.68	5.239	7.703
178	45.036	17.56	1.704	34.633	13.081	2486409	2477678	5/22/1998	07:25:16.48	4.923	7.702
179	45.011	17.527	1.7	34.639	13.082	2508540	2476940	5/22/1998	07:31:17.28	5.075	7.699
180	44.985	17.508	1.693	34.633	13.082	2521874	2476530	5/22/1998	07:37:18.08	5.166	7.697
181	44.962	17.475	1.653	34.641	13.08	2470629	2476918	5/22/1998	07:43:18.88	4.814	7.699
182	44.935	17.456	1.632	34.634	13.08	2530286	2477282	5/22/1998	07:49:19.68	5.224	7.701
183	44.911	17.436	1.638	34.63	13.08	2497136	2476602	5/22/1998	07:55:20.48	4.996	7.698
184	44.898	17.413	1.607	34.639	13.08	2499170	2476886	5/22/1998	08:01:21.28	5.010	7.699
185	44.885	17.399	1.589	34.64	13.078	2521135	2476775	5/22/1998	08:07:22.08	5.161	7.698
186	44.87	17.388	1.574	34.636	13.079	2520418	2476553	5/22/1998	08:13:22.88	5.156	7.697
187	44.856	17.368	1.555	34.641	13.079	2496176	2476810	5/22/1998	08:19:23.68	4.990	7.699
188	44.838	17.351	1.545	34.641	13.078	2495921	2476436	5/22/1998	08:25:24.48	4.988	7.697
189	44.827	17.338	1.525	34.642	13.076	2499587	2476681	5/22/1998	08:31:25.28	5.013	7.698
190	44.811	17.328	1.497	34.636	13.078	2456752	2476819	5/22/1998	08:37:26.08	4.719	7.699
191	44.799	17.326	1.459	34.628	13.078	2527192	2476673	5/22/1998	08:43:26.88	5.203	7.698
192	44.786	17.299	1.434	34.64	13.076	2544265	2476520	5/22/1998	08:49:27.68	5.320	7.697
193	44.773	17.287	1.378	34.64	13.074	2539162	2477420	5/22/1998	08:55:28.48	5.285	7.701
194	44.767	17.276	1.381	34.643	13.075	2530529	2476615	5/22/1998	09:01:29.28	5.225	7.698
195	44.76	17.276	1.358	34.637	13.074	2554847	2476194	5/22/1998	09:07:30.08	5.392	7.696
196	44.763	17.264	1.315	34.65	13.074	2394760	2476965	5/22/1998	09:13:30.88	4.294	7.699
197	44.752	17.261	1.284	34.643	13.074	2495131	2476273	5/22/1998	09:19:31.68	4.983	7.696
198	44.748	17.268	1.262	34.633	13.074	2522533	2476803	5/22/1998	09:25:32.48	5.171	7.698
199	44.752	17.262	1.209	34.643	13.073	2482657	2476080	5/22/1998	09:31:33.28	4.897	7.695
200	44.753	17.26	1.192	34.645	13.073	2531466	2476243	5/22/1998	09:37:34.08	5.232	7.696
201	44.763	17.272	1.135	34.644	13.072	2478414	2476247	5/22/1998	09:43:34.88	4.868	7.696
202	44.776	17.281	1.113	34.647	13.072	2512870	2476179	5/22/1998	09:49:35.68	5.104	7.696
203	44.782	17.3	1.069	34.636	13.072	2542990	2476101	5/22/1998	09:55:36.48	5.311	7.695
204	44.795	17.303	1.054	34.645	13.073	2514186	2476201	5/22/1998	10:01:37.28	5.113	7.696
205	44.815	17.328	1.03	34.64	13.072	2482869	2475749	5/22/1998	10:07:38.08	4.898	7.694

Record No.	Conductivity (mS/cm)	Temperature (Deg. C)	Pressure (dBar)	Salinity (PSU)	CTD Bat. (Vdc)	D.O. (Integer)	pH (Integer)	Date	Time	D.O. (ml/L)	pH (Value)
206	44.847	17.356	1.009	34.645	13.072	2521376	2476367	5/22/1998	10:13:38.88	5.163	7.697
207	44.879	17.389	0.99	34.644	13.072	2506430	2475594	5/22/1998	10:19:39.68	5.060	7.693
208	44.917	17.419	0.951	34.651	13.074	2501957	2475565	5/22/1998	10:25:40.48	5.029	7.693
209	44.951	17.46	0.973	34.646	13.073	2508257	2476163	5/22/1998	10:31:41.28	5.073	7.696
210	44.978	17.498	0.906	34.636	13.074	2527258	2476195	5/22/1998	10:37:42.08	5.203	7.696
211	45.01	17.53	0.841	34.636	13.074	2520040	2475221	5/22/1998	10:43:42.88	5.153	7.692
212	45.022	17.538	0.817	34.64	13.073	2511075	2476560	5/22/1998	10:50:24.90	5.092	7.697
213	45.043	17.565	0.761	34.634	13.072	2573094	2476536	5/22/1998	10:56:25.70	5.518	7.697
214	45.069	17.588	0.727	34.637	13.072	2553586	2477014	5/22/1998	11:02:26.50	5.384	7.699
215	45.095	17.611	0.737	34.64	13.071	2555903	2476480	5/22/1998	11:08:27.30	5.400	7.697
216	45.117	17.635	0.716	34.639	13.072	2484253	2475660	5/22/1998	11:14:28.10	4.908	7.694
217	45.157	17.669	0.678	34.644	13.07	2479726	2476035	5/22/1998	11:20:28.90	4.877	7.695
218	45.186	17.701	0.649	34.642	13.072	2419273	2476067	5/22/1998	11:26:29.70	4.462	7.695
219	45.2	17.717	0.647	34.64	13.072	2497828	2475766	5/22/1998	11:32:30.50	5.001	7.694
220	45.223	17.742	0.609	34.639	13.072	2519695	2475132	5/22/1998	11:38:31.30	5.151	7.691
221	45.242	17.764	0.579	34.636	13.072	2544067	2474886	5/22/1998	11:44:32.10	5.318	7.690
222	45.253	17.766	0.543	34.644	13.071	2432940	2475029	5/22/1998	11:50:32.90	4.556	7.691
223	45.283	17.8	0.534	34.641	13.071	2537971	2475207	5/22/1998	11:56:33.70	5.277	7.692
224	45.317	17.843	0.501	34.634	13.072	2562296	2475944	5/22/1998	12:02:34.50	5.443	7.695
225	45.348	17.875	0.495	34.633	13.073	2440713	2474609	5/22/1998	12:08:35.30	4.609	7.689
226	45.376	17.893	0.508	34.641	13.072	2602873	2474617	5/22/1998	12:14:36.10	5.722	7.689
227	45.41	17.927	0.487	34.641	13.073	2501132	2473855	5/22/1998	12:20:36.90	5.024	7.686
228	45.438	17.952	0.466	34.644	13.073	2524167	2474290	5/22/1998	12:26:37.70	5.182	7.688
229	45.469	17.987	0.465	34.641	13.073	2536048	2474344	5/22/1998	12:32:38.50	5.263	7.688
230	45.501	18.018	0.43	34.642	13.072	2545965	2474540	5/22/1998	12:38:39.30	5.331	7.689
231	45.532	18.061	0.458	34.632	13.072	2533242	2474607	5/22/1998	12:44:40.10	5.244	7.689
232	45.573	18.097	0.398	34.636	13.074	2542412	2474832	5/22/1998	12:50:40.90	5.307	7.690
233	45.607	18.132	0.424	34.635	13.072	2537286	2475282	5/22/1998	12:56:41.70	5.272	7.692
234	45.649	18.191	0.424	34.621	13.073	2557397	2474541	5/22/1998	13:02:42.50	5.410	7.689
235	45.682	18.208	0.426	34.635	13.075	2572214	2475073	5/22/1998	13:08:43.30	5.512	7.691
236	45.71	18.237	0.444	34.635	13.075	2601694	2475205	5/22/1998	13:14:44.10	5.714	7.692
237	45.738	18.261	0.434	34.638	13.073	2522882	2475577	5/22/1998	13:20:44.90	5.173	7.693
238	45.77	18.288	0.47	34.642	13.074	2566391	2475066	5/22/1998	13:26:45.70	5.472	7.691
239	45.795	18.328	0.452	34.629	13.073	2572739	2475476	5/22/1998	13:32:46.50	5.515	7.693
240	45.821	18.348	0.457	34.635	13.073	2469582	2475410	5/22/1998	13:38:47.30	4.807	7.692
241	45.855	18.386	0.44	34.631	13.072	2546359	2475661	5/22/1998	13:44:48.10	5.334	7.694
242	45.878	18.403	0.449	34.636	13.073	2562619	2475641	5/22/1998	13:50:48.90	5.446	7.693
243	45.896	18.429	0.512	34.63	13.072	2531384	2475645	5/22/1998	13:56:49.70	5.231	7.693
244	45.919	18.447	0.525	34.634	13.073	2586375	2475526	5/22/1998	14:02:50.50	5.609	7.693
245	45.936	18.463	0.523	34.635	13.072	2432841	2476249	5/22/1998	14:08:51.30	4.555	7.696
246	45.956	18.481	0.574	34.637	13.074	2596008	2475959	5/22/1998	14:14:52.10	5.675	7.695
247	45.972	18.506	0.598	34.629	13.074	2559090	2476459	5/22/1998	14:20:52.90	5.421	7.697
248	45.987	18.518	0.618	34.632	13.073	2567108	2475733	5/22/1998	14:26:53.70	5.477	7.694
249	46.011	18.548	0.631	34.627	13.072	2580755	2476464	5/22/1998	14:32:54.50	5.570	7.697
250	46.028	18.555	0.658	34.635	13.071	2590000	2476157	5/22/1998	14:38:55.30	5.634	7.696
251	46.038	18.564	0.668	34.636	13.071	2629935	2476675	5/22/1998	14:44:56.10	5.908	7.698
252	46.051	18.583	0.702	34.631	13.07	2587591	2476883	5/22/1998	14:50:56.90	5.617	7.699
253	46.061	18.593	0.709	34.631	13.071	2554636	2476962	5/22/1998	14:56:57.70	5.391	7.699
254	46.069	18.607	0.741	34.626	13.071	2549037	2477047	5/22/1998	15:02:58.50	5.352	7.700
255	46.083	18.615	0.8	34.631	13.07	2589924	2476830	5/22/1998	15:08:59.30	5.633	7.699
256	46.083	18.617	0.809	34.629	13.071	2532447	2476741	5/22/1998	15:15:00.10	5.239	7.698
257	46.097	18.624	0.848	34.636	13.069	2553231	2477012	5/22/1998	15:21:00.90	5.381	7.699
258	46.104	18.639	0.902	34.629	13.07	2565389	2477423	5/22/1998	15:27:01.70	5.465	7.701
259	46.098	18.63	0.946	34.631	13.07	2535611	2478286	5/22/1998	15:33:02.50	5.260	7.705
260	46.088	18.613	0.971	34.637	13.069	2590498	2478543	5/22/1998	15:39:03.30	5.637	7.706
261	46.065	18.595	0.985	34.632	13.069	2590037	2478087	5/22/1998	15:45:04.10	5.634	7.704
262	46.045	18.573	1.009	34.634	13.069	2567389	2478166	5/22/1998	15:51:04.90	5.478	7.704
263	46.024	18.551	1.03	34.636	13.066	2563393	2478502	5/22/1998	15:57:05.70	5.451	7.706
264	46.002	18.529	1.044	34.635	13.066	2615503	2477569	5/22/1998	16:03:06.50	5.809	7.702
265	45.98	18.504	1.101	34.637	13.066	2611635	2477929	5/22/1998	16:09:07.30	5.782	7.703
266	45.959	18.483	1.186	34.637	13.064	2531634	2478889	5/22/1998	16:15:08.10	5.233	7.707
267	45.935	18.458	1.236	34.639	13.064	2615934	2478497	5/22/1998	16:21:08.90	5.812	7.706
268	45.911	18.434	1.249	34.638	13.064	2617829	2478638	5/22/1998	16:27:09.70	5.825	7.706
269	45.882	18.407	1.26	34.636	13.062	2568530	2479045	5/22/1998	16:33:10.50	5.486	7.708
270	45.854	18.375	1.314	34.64	13.062	2598543	2478537	5/22/1998	16:39:11.30	5.692	7.706
271	45.819	18.346	1.34	34.634	13.062	2552557	2478703	5/22/1998	16:45:12.10	5.377	7.707
272	45.784	18.309	1.384	34.636	13.06	2549410	2478786	5/22/1998	16:51:12.90	5.355	7.707
273	45.753	18.274	1.421	34.64	13.061	2590254	2478743	5/22/1998	16:57:13.70	5.635	7.707
274	45.718	18.239	1.462	34.639	13.061	2545525	2479306	5/22/1998	17:03:14.50	5.328	7.709
275	45.687	18.202	1.505	34.644	13.059	2555879	2479001	5/22/1998	17:09:15.30	5.399	7.708
276	45.649	18.156	1.511	34.651	13.058	2579929	2478432	5/22/1998	17:15:16.10	5.565	7.706
277	45.622	18.129	1.547	34.65	13.057	2555170	2478719	5/22/1998	17:21:16.90	5.395	7.707
278	45.583	18.093	1.532	34.648	13.057	2577298	2479581	5/22/1998	17:27:17.70	5.546	7.710
279	45.554	18.063	1.618	34.648	13.057	2600785	2479058	5/22/1998	17:33:18.50	5.708	7.708
280	45.521	18.033	1.604	34.646	13.056	2555234	2479098	5/22/1998	17:39:19.30	5.395	7.708
281	45.491	18.005	1.644	34.644	13.056	2531467	2479407	5/22/1998	17:45:20.10	5.232	7.710
282	45.453	17.96	1.676	34.649	13.055	2547282	2479640	5/22/1998	17:52:02.15	5.340	7.711
283	45.421	17.91	1.711	34.665	13.055	2540432	2479686	5/22/1998	17:58:02.95	5.293	7.711
284	45.378	17.877	1.752	34.656	13.054	2560748	2479403	5/22/1998	18:04:03.75	5.433	7.710
285	45.333	17.833	1.743	34.656	13.053	2538473	2479535	5/22/1998	18:10:04.55	5.280	7.710
286	45.291	17.789	1.756	34.656	13.052	2541569	2479947	5/22/1998	18:16:05.35	5.301	7.712
287	45.255	17.758	1.784	34.652	13.051	2518730	2479962	5/22/1998	18:22:06.15	5.144	7.712
288	45.206	17.699	1.795	34.661	13.05	2581636	2480060	5/22/1998	18:28:06.95	5.576	7.713
289	45.156	17.645	1.831	34.664	13.048	2522983	2479464	5/22/1998	18:34:07.75	5.174	7.710
290	45.1	17.594	1.863	34.659	13.049	2551811	2479704	5/22/1998	18:40:08.55	5.372	7.711
291	45.057	17.553	1.832	34.657	13.048	2555795	2480717	5/22/1998	18:46:09.35	5.399	7.715
292	45.013	17.51	1.848	34.656	13.047	2572267	2479715	5/22/1998	18:52:10.15	5.512	7.711
293	44.968	17.463	1.819	34.656	13.047	2562524	2480199	5/22/1998	18:58:10.95	5.445	7.713
294	44.94	17.433	1.844	34.658	13.046	2527876	2480112	5/22/1998	19:04:11.75	5.207	7.713
295	44.907	17.377	1.85	34.678	13.047	2528236	2480174	5/22/1998	19:10:12.55	5.210	7.713
296	44.879	17.366	1.904	34.663	13.047	2536020	2480288	5/22/1998	19:16:13.35	5.263	7.714
297	44.858	17.339	1.915	34.668	13.047	2530089	2481096	5/22/1998	19:22:14.15	5.222	7.717
298	44.835	17.313	1.881	34.67	13.045	2501618	2480710	5/22/1998	19:28:14.95	5.027	7.715
299	44.804	17.292	1.841	34.662	13.044	2516179	2480394	5/22/1998	19:34:15.75	5.127	7.714

Record No.	Conductivity (mS/cm)	Temperature (Deg. C)	Pressure (dBar)	Salinity (PSU)	CTD Bat. (Vdc)	D.O. (Integer)	pH (Integer)	Date	Time	D.O. (ml/L)	pH (Value)
300	44.787	17.259	1.846	34.675	13.046	2494858	2480956	5/22/1998	19:40:16.55	4.981	7.716
301	44.756	17.239	1.801	34.666	13.047	2544731	2479916	5/22/1998	19:46:17.35	5.323	7.712
302	44.735	17.216	1.817	34.667	13.043	2517467	2480882	5/22/1998	19:52:18.15	5.136	7.716
303	44.716	17.205	1.779	34.66	13.045	2549646	2480589	5/22/1998	19:58:18.95	5.357	7.715
304	44.695	17.163	1.791	34.678	13.043	2521162	2480455	5/22/1998	20:04:19.75	5.161	7.714
305	44.676	17.143	1.777	34.679	13.042	2518000	2480039	5/22/1998	20:10:20.55	5.139	7.712
306	44.657	17.115	1.799	34.687	13.042	2574959	2479869	5/22/1998	20:16:21.35	5.530	7.712
307	44.636	17.103	1.73	34.678	13.041	2532930	2480393	5/22/1998	20:22:22.15	5.242	7.714
308	44.614	17.089	1.688	34.671	13.043	2532986	2479990	5/22/1998	20:28:22.95	5.242	7.712
309	44.595	17.058	1.643	34.682	13.04	2517637	2480252	5/22/1998	20:34:23.75	5.137	7.713
310	44.572	17.057	1.645	34.662	13.04	2465567	2480180	5/22/1998	20:40:24.55	4.780	7.713
311	44.563	17.021	1.581	34.686	13.039	2502866	2480502	5/22/1998	20:46:25.35	5.036	7.714
312	44.553	17.018	1.578	34.679	13.039	2543391	2480776	5/22/1998	20:52:26.15	5.314	7.716
313	44.534	16.996	1.56	34.682	13.039	2492834	2480874	5/22/1998	20:58:26.95	4.967	7.716
314	44.532	16.991	1.518	34.685	13.04	2484181	2480518	5/22/1998	21:04:27.75	4.907	7.715
315	44.519	16.989	1.472	34.674	13.041	2551100	2480860	5/22/1998	21:10:28.55	5.367	7.716
316	44.505	16.975	1.414	34.674	13.038	2534409	2480932	5/22/1998	21:16:29.35	5.252	7.716
317	44.494	16.962	1.39	34.676	13.038	2503673	2481790	5/22/1998	21:22:30.15	5.041	7.720
318	44.487	16.96	1.336	34.672	13.038	2505018	2480901	5/22/1998	21:28:30.95	5.050	7.716
319	44.476	16.944	1.304	34.676	13.037	2527721	2481551	5/22/1998	21:34:31.75	5.206	7.719
320	44.473	16.942	1.288	34.676	13.038	2497366	2482178	5/22/1998	21:40:32.55	4.998	7.722
321	44.471	16.933	1.222	34.681	13.037	2540504	2480869	5/22/1998	21:46:33.35	5.294	7.716
322	44.464	16.927	1.178	34.681	13.037	2500477	2481066	5/22/1998	21:52:34.15	5.019	7.717
323	44.472	16.933	1.132	34.683	13.037	2493677	2480772	5/22/1998	21:58:34.95	4.973	7.716
324	44.471	16.932	1.084	34.682	13.037	2555636	2481482	5/22/1998	22:04:35.75	5.398	7.719
325	44.475	16.937	1.059	34.681	13.036	2541651	2482014	5/22/1998	22:10:36.55	5.302	7.721
326	44.48	16.94	0.999	34.683	13.039	2510246	2481305	5/22/1998	22:16:37.35	5.086	7.718
327	44.486	16.947	0.937	34.683	13.035	2502953	2481824	5/22/1998	22:22:38.15	5.036	7.720
328	44.503	16.959	0.901	34.687	13.036	2551338	2481762	5/22/1998	22:28:38.95	5.368	7.720
329	44.518	16.966	0.866	34.693	13.036	2549862	2481929	5/22/1998	22:34:39.75	5.358	7.721
330	44.54	17.007	0.831	34.678	13.035	2565331	2481888	5/22/1998	22:40:40.55	5.464	7.720
331	44.567	17.032	0.778	34.68	13.036	2511606	2481505	5/22/1998	22:46:41.35	5.096	7.719
332	44.599	17.056	0.721	34.687	13.036	2563539	2481368	5/22/1998	22:52:42.15	5.452	7.718
333	44.617	17.088	0.671	34.675	13.036	2572075	2481500	5/22/1998	22:58:42.95	5.511	7.719
334	44.662	17.121	0.634	34.686	13.036	2522143	2481644	5/22/1998	23:04:43.75	5.168	7.719
335	44.694	17.157	0.625	34.683	13.036	2498086	2482211	5/22/1998	23:10:44.55	5.003	7.722
336	44.723	17.191	0.594	34.678	13.037	2529994	2481445	5/22/1998	23:16:45.35	5.222	7.719
337	44.756	17.212	0.533	34.689	13.036	2505395	2481385	5/22/1998	23:22:46.15	5.053	7.718
338	44.786	17.255	0.486	34.678	13.036	2516920	2481856	5/22/1998	23:28:46.95	5.132	7.720
339	44.812	17.279	0.439	34.681	13.036	2528784	2481838	5/22/1998	23:34:47.75	5.213	7.720
340	44.842	17.318	0.403	34.673	13.037	2541116	2481893	5/22/1998	23:40:48.55	5.298	7.720
341	44.886	17.352	0.364	34.682	13.037	2524601	2481596	5/22/1998	23:46:49.35	5.185	7.719
342	44.91	17.386	0.315	34.673	13.04	2480835	2481857	5/22/1998	23:52:50.15	4.884	7.720
343	44.917	17.392	0.296	34.674	13.037	2529532	2481861	5/22/1998	23:58:50.95	5.219	7.720
344	44.946	17.418	0.253	34.678	13.036	2512864	2481803	5/23/1998	00:04:51.75	5.104	7.720
345	44.989	17.47	0.239	34.669	13.036	2486088	2481248	5/23/1998	00:10:52.55	4.920	7.718
346	45.025	17.513	0.2	34.664	13.037	2530735	2482099	5/23/1998	00:16:53.35	5.227	7.721
347	45.072	17.544	0.171	34.678	13.038	2567634	2481896	5/23/1998	00:22:54.15	5.480	7.720
348	45.111	17.585	0.127	34.676	13.039	2596736	2481618	5/23/1998	00:28:54.95	5.680	7.719
349	45.138	17.614	0.102	34.675	13.039	2544673	2481384	5/23/1998	00:34:55.75	5.323	7.718
350	45.154	17.637	0.053	34.669	13.037	2516014	2481507	5/23/1998	00:40:56.55	5.126	7.719
351	45.188	17.661	0.039	34.677	13.038	2546135	2481698	5/23/1998	00:46:57.35	5.333	7.720
352	45.223	17.703	0.014	34.672	13.037	2526513	2481972	5/23/1998	00:53:39.39	5.198	7.721
353	45.269	17.741	0	34.68	13.037	2555885	2482028	5/23/1998	00:59:40.19	5.399	7.721
354	45.306	17.783	-0.014	34.675	13.038	2590430	2481398	5/23/1998	01:05:40.99	5.637	7.718
355	45.333	17.823	-0.037	34.665	13.038	2553058	2481499	5/23/1998	01:11:41.79	5.380	7.719
356	45.366	17.854	-0.062	34.666	13.039	2526912	2481095	5/23/1998	01:17:42.59	5.201	7.717
357	45.404	17.884	-0.071	34.673	13.038	2540613	2481352	5/23/1998	01:23:43.39	5.295	7.718
358	45.452	17.934	-0.095	34.672	13.038	2556517	2482037	5/23/1998	01:29:44.19	5.404	7.721
359	45.495	17.976	-0.105	34.673	13.038	2548104	2481425	5/23/1998	01:35:44.99	5.346	7.718
360	45.531	18.013	-0.117	34.672	13.039	2592367	2481265	5/23/1998	01:41:45.79	5.650	7.718
361	45.565	18.058	-0.109	34.662	13.038	2556901	2481470	5/23/1998	01:47:46.59	5.406	7.719
362	45.606	18.087	-0.102	34.673	13.039	2498739	2481178	5/23/1998	01:53:47.39	5.007	7.717
363	45.638	18.128	-0.099	34.665	13.04	2560534	2480973	5/23/1998	01:59:48.19	5.431	7.716
364	45.68	18.162	-0.094	34.673	13.04	2512583	2481180	5/23/1998	02:05:48.99	5.102	7.717
365	45.709	18.19	-0.12	34.674	13.04	2564208	2481543	5/23/1998	02:11:49.79	5.457	7.719
366	45.746	18.229	-0.131	34.672	13.039	2543685	2480836	5/23/1998	02:17:50.59	5.316	7.716
367	45.778	18.264	-0.101	34.67	13.038	2568551	2481195	5/23/1998	02:23:51.39	5.486	7.717
368	45.805	18.29	-0.099	34.67	13.041	2560673	2480921	5/23/1998	02:29:52.19	5.432	7.716
369	45.836	18.326	-0.105	34.666	13.038	2558218	2480783	5/23/1998	02:35:52.99	5.416	7.716
370	45.857	18.351	-0.102	34.663	13.04	2545895	2481259	5/23/1998	02:41:53.79	5.331	7.718
371	45.876	18.374	-0.055	34.659	13.04	2599323	2481012	5/23/1998	02:47:54.59	5.698	7.717
372	45.91	18.405	-0.045	34.662	13.04	2545121	2480984	5/23/1998	02:53:55.39	5.326	7.717
373	45.934	18.43	-0.026	34.661	13.038	2522353	2480654	5/23/1998	02:59:56.19	5.169	7.715
374	45.953	18.453	-0.013	34.658	13.04	2590378	2481112	5/23/1998	03:05:56.99	5.636	7.717
375	45.973	18.47	-0.011	34.66	13.04	2548980	2481494	5/23/1998	03:11:57.79	5.352	7.719
376	45.995	18.487	0.016	34.665	13.039	2479335	2481220	5/23/1998	03:17:58.59	4.874	7.718
377	46.02	18.506	0.075	34.67	13.04	2602047	2480708	5/23/1998	03:23:59.39	5.716	7.715
378	46.041	18.544	0.104	34.655	13.04	2540454	2481055	5/23/1998	03:30:00.19	5.294	7.717
379	46.061	18.567	0.104	34.653	13.038	2556218	2480031	5/23/1998	03:36:00.99	5.402	7.712
380	46.083	18.58	0.105	34.661	13.039	2550058	2480823	5/23/1998	03:42:01.79	5.359	7.716
381	46.1	18.601	0.158	34.657	13.04	2565084	2480477	5/23/1998	03:48:02.59	5.463	7.714
382	46.125	18.62	0.198	34.663	13.041	2541682	2480354	5/23/1998	03:54:03.39	5.302	7.714
383	46.144	18.639	0.229	34.662	13.04	2560697	2480492	5/23/1998	04:00:04.19	5.433	7.714
384	46.156	18.647	0.264	34.666	13.041	2593683	2480358	5/23/1998	04:06:04.99	5.659	7.714
385	46.168	18.667	0.274	34.659	13.039	2549187	2480180	5/23/1998	04:12:05.79	5.354	7.713
386	46.183	18.689	0.325	34.653	13.037	2614653	2479799	5/23/1998	04:18:06.59	5.803	7.711
387	46.199	18.697	0.367	34.66	13.041	2551814	2479998	5/23/1998	04:24:07.39	5.372	7.712
388	46.205	18.705	0.403	34.658	13.036	2572861	2480206	5/23/1998	04:30:08.19	5.516	7.713
389	46.206	18.702	0.426	34.662	13.037	2581931	2480111	5/23/1998	04:36:08.99	5.578	7.713
390	46.196	18.701	0.443	34.654	13.036	2566662	2479960	5/23/1998	04:42:09.79	5.473	7.712
391	46.181	18.681	0.466	34.658	13.041	2544687	2480039	5/23/1998	04:48:10.59	5.323	7.712
392	46.173	18.671	0.51	34.659	13.037	2605728	2480230	5/23/1998	04:54:11.39	5.742	7.713
393	46.152	18.655	0.554	34.656	13.037	2603563	2479793	5/23/1998	05:00:12.19	5.727	7.711

Record No.	Conductivity (mS/cm)	Temperature (Deg. C)	Pressure (dBar)	Salinity (PSU)	CTD Bat. (Vdc)	D.O. (Integer)	pH (Integer)	Date	Time	D.O. (ml/L)	pH (Value)
394	46.141	18.635	0.57	34.664	13.034	2567619	2480371	5/23/1998	05:06:12.99	5.480	7.714
395	46.12	18.621	0.622	34.657	13.034	2580806	2479782	5/23/1998	05:12:13.79	5.571	7.711
396	46.103	18.604	0.649	34.657	13.035	2556223	2480113	5/23/1998	05:18:14.59	5.402	7.713
397	46.087	18.584	0.708	34.66	13.034	2573353	2479766	5/23/1998	05:24:15.39	5.519	7.711
398	46.068	18.562	0.727	34.663	13.033	2546761	2479405	5/23/1998	05:30:16.19	5.337	7.710
399	46.053	18.553	0.747	34.657	13.033	2543820	2480263	5/23/1998	05:36:16.99	5.317	7.713
400	46.042	18.531	0.758	34.667	13.032	2560063	2478851	5/23/1998	05:42:17.79	5.428	7.707
401	46.025	18.518	0.807	34.664	13.032	2552301	2479747	5/23/1998	05:48:18.59	5.375	7.711
402	45.994	18.496	0.828	34.656	13.032	2570116	2479852	5/23/1998	05:54:19.39	5.497	7.712
403	45.97	18.469	0.86	34.659	13.032	2543335	2479850	5/23/1998	06:00:20.19	5.313	7.712
404	45.952	18.441	0.904	34.666	13.031	2525443	2479693	5/23/1998	06:06:20.99	5.191	7.711
405	45.93	18.418	0.93	34.667	13.031	2558889	2479306	5/23/1998	06:12:21.79	5.420	7.709
406	45.908	18.395	0.97	34.669	13.029	2553385	2479460	5/23/1998	06:18:22.59	5.382	7.710
407	45.881	18.376	0.974	34.662	13.029	2600458	2479745	5/23/1998	06:24:23.39	5.705	7.711
408	45.861	18.354	1.024	34.663	13.03	2569088	2479341	5/23/1998	06:30:24.19	5.490	7.709
409	45.843	18.337	1.019	34.663	13.029	2526933	2479083	5/23/1998	06:36:24.99	5.201	7.708
410	45.816	18.304	1.004	34.667	13.028	2537581	2479577	5/23/1998	06:42:25.79	5.274	7.710
411	45.799	18.277	1.03	34.676	13.031	2599347	2479143	5/23/1998	06:48:26.59	5.698	7.709
412	45.78	18.265	1.097	34.67	13.027	2554368	2479341	5/23/1998	06:54:27.39	5.389	7.709
413	45.749	18.235	1.118	34.668	13.025	2525123	2479203	5/23/1998	07:00:28.19	5.188	7.709
414	45.705	18.198	1.132	34.663	13.025	2519614	2479449	5/23/1998	07:06:28.99	5.151	7.710
415	45.682	18.167	1.151	34.669	13.025	2533448	2479207	5/23/1998	07:12:29.79	5.246	7.709
416	45.654	18.141	1.143	34.667	13.026	2555954	2479500	5/23/1998	07:18:30.59	5.400	7.710
417	45.633	18.115	1.157	34.672	13.025	2430381	2479267	5/23/1998	07:24:31.39	4.538	7.709
418	45.608	18.09	1.174	34.672	13.024	2501958	2478975	5/23/1998	07:30:32.19	5.029	7.708
419	45.584	18.07	1.17	34.668	13.023	2524197	2479309	5/23/1998	07:36:32.99	5.182	7.709
420	45.549	18.033	1.186	34.67	13.022	2517803	2478930	5/23/1998	07:42:33.79	5.138	7.708
421	45.526	17.996	1.168	34.682	13.021	2518339	2478972	5/23/1998	07:48:34.59	5.142	7.708
422	45.486	17.966	1.173	34.673	13.021	2552188	2478608	5/23/1998	07:55:16.65	5.374	7.706
423	45.457	17.929	1.192	34.679	13.021	2544192	2479825	5/23/1998	08:01:17.45	5.319	7.712
424	45.422	17.907	1.171	34.668	13.022	2536213	2479450	5/23/1998	08:07:18.25	5.264	7.710
425	45.399	17.872	1.178	34.678	13.019	2519791	2479019	5/23/1998	08:13:19.05	5.152	7.708
426	45.369	17.838	1.173	34.682	13.02	2557432	2478595	5/23/1998	08:19:19.85	5.410	7.706
427	45.345	17.817	1.189	34.68	13.02	2507943	2479244	5/23/1998	08:25:20.65	5.070	7.709
428	45.328	17.792	1.144	34.686	13.02	2501972	2478712	5/23/1998	08:31:21.45	5.029	7.707
429	45.312	17.785	1.122	34.678	13.018	2550992	2479040	5/23/1998	08:37:22.25	5.366	7.708
430	45.29	17.76	1.123	34.681	13.017	2534530	2478846	5/23/1998	08:43:23.05	5.253	7.707
431	45.274	17.738	1.118	34.686	13.019	2591470	2478496	5/23/1998	08:49:23.85	5.644	7.706
432	45.255	17.731	1.101	34.675	13.017	2521083	2478329	5/23/1998	08:55:24.65	5.161	7.705
433	45.239	17.706	1.057	34.684	13.017	2508457	2478320	5/23/1998	09:01:25.45	5.074	7.705
434	45.232	17.701	1.037	34.681	13.017	2506494	2478702	5/23/1998	09:07:26.25	5.061	7.707
435	45.219	17.691	1.023	34.679	13.019	2531824	2479250	5/23/1998	09:13:27.05	5.234	7.709
436	45.209	17.68	1.041	34.68	13.018	2517963	2478876	5/23/1998	09:19:27.85	5.139	7.707
437	45.196	17.671	1.002	34.676	13.016	2528560	2478525	5/23/1998	09:25:28.65	5.212	7.706
438	45.181	17.645	0.956	34.685	13.015	2565673	2478672	5/23/1998	09:31:29.45	5.467	7.707
439	45.164	17.633	0.911	34.681	13.017	2546406	2478298	5/23/1998	09:37:30.25	5.334	7.705
440	45.148	17.624	0.909	34.674	13.014	2517827	2479205	5/23/1998	09:43:31.05	5.138	7.709
441	45.132	17.594	0.92	34.686	13.014	2531457	2478239	5/23/1998	09:49:31.85	5.232	7.705
442	45.123	17.586	0.88	34.685	13.014	2512794	2478250	5/23/1998	09:55:32.65	5.104	7.705
443	45.11	17.578	0.822	34.681	13.016	2548249	2478050	5/23/1998	10:01:33.45	5.347	7.704
444	45.102	17.569	0.779	34.682	13.014	2534234	2478375	5/23/1998	10:07:34.25	5.251	7.705
445	45.089	17.56	0.737	34.679	13.014	2516836	2478096	5/23/1998	10:13:35.05	5.131	7.704
446	45.091	17.56	0.71	34.68	13.015	2518174	2477505	5/23/1998	10:19:35.85	5.141	7.702
447	45.081	17.547	0.68	34.683	13.013	2514741	2478221	5/23/1998	10:25:36.65	5.117	7.705
448	45.079	17.539	0.609	34.689	13.013	2500781	2477760	5/23/1998	10:31:37.45	5.021	7.703
449	45.072	17.536	0.548	34.685	13.012	2534647	2477540	5/23/1998	10:37:38.25	5.254	7.702
450	45.079	17.543	0.58	34.685	13.013	2563901	2477984	5/23/1998	10:43:39.05	5.455	7.704
451	45.093	17.551	0.558	34.69	13.013	2524513	2478610	5/23/1998	10:49:39.85	5.184	7.706
452	45.11	17.575	0.526	34.685	13.013	2478230	2478030	5/23/1998	10:55:40.65	4.867	7.704
453	45.128	17.593	0.549	34.684	13.013	2582847	2477865	5/23/1998	11:01:41.45	5.585	7.703
454	45.141	17.612	0.458	34.679	13.013	2525097	2477944	5/23/1998	11:07:42.25	5.188	7.703
455	45.17	17.637	0.44	34.683	13.013	2527647	2477413	5/23/1998	11:13:43.05	5.206	7.701
456	45.188	17.662	0.407	34.677	13.014	2557564	2477671	5/23/1998	11:19:43.85	5.411	7.702
457	45.217	17.691	0.357	34.678	13.015	2525942	2477373	5/23/1998	11:25:44.65	5.194	7.701
458	45.231	17.701	0.294	34.68	13.013	2556153	2477652	5/23/1998	11:31:45.45	5.401	7.702
459	45.248	17.713	0.292	34.685	13.014	2569279	2476591	5/23/1998	11:37:46.25	5.491	7.698
460	45.269	17.729	0.259	34.689	13.014	2509790	2477083	5/23/1998	11:43:47.05	5.083	7.700
461	45.292	17.767	0.257	34.677	13.013	2512965	2476853	5/23/1998	11:49:47.85	5.105	7.699
462	45.305	17.777	0.242	34.679	13.014	2566893	2476984	5/23/1998	11:55:48.65	5.475	7.699
463	45.313	17.782	0.142	34.681	13.012	2525979	2477031	5/23/1998	12:01:49.45	5.194	7.699
464	45.329	17.8	0.128	34.68	13.014	2525679	2476737	5/23/1998	12:07:50.25	5.192	7.698
465	45.348	17.825	0.134	34.676	13.013	2550772	2477175	5/23/1998	12:13:51.05	5.364	7.700
466	45.379	17.847	0.122	34.683	13.014	2547300	2476558	5/23/1998	12:19:51.85	5.341	7.697
467	45.405	17.873	0.097	34.683	13.016	2571228	2476897	5/23/1998	12:25:52.65	5.505	7.699
468	45.425	17.885	0.063	34.691	13.014	2547223	2476299	5/23/1998	12:31:53.45	5.340	7.696
469	45.445	17.919	0.069	34.678	13.014	2578308	2476455	5/23/1998	12:37:54.25	5.553	7.697
470	45.475	17.948	0.017	34.679	13.016	2559621	2476264	5/23/1998	12:43:55.05	5.425	7.696
471	45.505	17.976	0	34.681	13.015	2570899	2477794	5/23/1998	12:49:55.85	5.503	7.703
472	45.537	18.009	0.002	34.681	13.015	2545682	2476519	5/23/1998	12:55:56.65	5.329	7.697
473	45.553	18.036	-0.023	34.671	13.016	2582263	2476201	5/23/1998	13:01:57.45	5.581	7.696
474	45.589	18.062	-0.049	34.679	13.014	2531513	2476566	5/23/1998	13:07:58.25	5.232	7.697
475	45.624	18.097	-0.037	34.68	13.014	2573840	2477014	5/23/1998	13:13:59.05	5.523	7.699
476	45.647	18.124	-0.048	34.676	13.015	2583203	2476824	5/23/1998	13:19:59.85	5.587	7.699
477	45.675	18.148	-0.068	34.68	13.015	2518249	2476829	5/23/1998	13:26:00.65	5.141	7.699
478	45.706	18.187	-0.057	34.673	13.014	2553641	2477265	5/23/1998	13:32:01.45	5.384	7.700
479	45.745	18.223	-0.059	34.676	13.017	2569545	2476364	5/23/1998	13:38:02.25	5.493	7.697
480	45.779	18.252	-0.045	34.681	13.016	2481423	2476294	5/23/1998	13:44:03.05	4.888	7.696
481	45.808	18.287	-0.065	34.676	13.016	2595313	2476444	5/23/1998	13:50:03.85	5.670	7.697
482	45.847	18.32	-0.043	34.681	13.017	2582524	2477134	5/23/1998	13:56:04.65	5.582	7.700
483	45.886	18.365	-0.057	34.675	13.018	2575951	2476881	5/23/1998	14:02:05.45	5.537	7.699
484	45.915	18.405	-0.051	34.666	13.016	2563593	2477154	5/23/1998	14:08:06.25	5.452	7.700
485	45.93	18.42	-0.059	34.666	13.016	2535607	2477318	5/23/1998	14:14:07.05	5.260	7.701
486	45.977	18.456	-0.038	34.676	13.015	2637619	2477696	5/23/1998	14:20:07.85	5.960	7.702
487	46.01	18.493	-0.002	34.673	13.016	2545646	2477409	5/23/1998	14:26:08.65	5.329	7.701

Record No.	Conductivity (mS/cm)	Temperature (Deg. C)	Pressure (dBar)	Salinity (PSU)	CTD Bat. (Vdc)	D.O. (Integer)	pH (Integer)	Date	Time	D.O. (ml/L)	pH (Value)
488	46.045	18.535	0.016	34.666	13.016	2557096	2477579	5/23/1998	14:32:09.45	5.408	7.702
489	46.081	18.572	0.034	34.666	13.017	2599859	2477999	5/23/1998	14:38:10.25	5.701	7.704
490	46.114	18.602	0.052	34.668	13.018	2561174	2477664	5/23/1998	14:44:11.05	5.436	7.702
491	46.149	18.63	0.096	34.675	13.016	2600665	2478497	5/23/1998	14:50:11.85	5.707	7.706
492	46.171	18.66	0.11	34.667	13.015	2615404	2478598	5/23/1998	14:56:53.91	5.808	7.706
493	46.203	18.688	0.1	34.67	13.016	2574101	2478563	5/23/1998	15:02:54.71	5.525	7.706
494	46.221	18.709	0.116	34.668	13.015	2588684	2479002	5/23/1998	15:08:55.51	5.625	7.708
495	46.244	18.737	0.14	34.664	13.017	2612098	2478674	5/23/1998	15:14:56.31	5.785	7.707
496	46.259	18.748	0.193	34.667	13.015	2611134	2478829	5/23/1998	15:20:57.11	5.779	7.707
497	46.272	18.753	0.224	34.674	13.014	2568264	2479249	5/23/1998	15:26:57.91	5.484	7.709
498	46.28	18.768	0.265	34.668	13.016	2608994	2478914	5/23/1998	15:32:58.71	5.764	7.708
499	46.29	18.774	0.275	34.672	13.015	2619546	2478946	5/23/1998	15:38:59.51	5.836	7.708
500	46.292	18.786	0.334	34.663	13.014	2614175	2479754	5/23/1998	15:45:00.31	5.800	7.711
501	46.309	18.791	0.381	34.673	13.015	2590866	2479348	5/23/1998	15:51:01.11	5.640	7.709
502	46.313	18.792	0.395	34.675	13.016	2585067	2480068	5/23/1998	15:57:01.91	5.600	7.713
503	46.309	18.796	0.412	34.669	13.015	2602026	2479585	5/23/1998	16:03:02.71	5.716	7.710
504	46.319	18.8	0.431	34.674	13.015	2613919	2479851	5/23/1998	16:09:03.51	5.798	7.712
505	46.32	18.797	0.487	34.678	13.014	2576471	2479816	5/23/1998	16:15:04.31	5.541	7.711
506	46.311	18.789	0.498	34.676	13.013	2618894	2480055	5/23/1998	16:21:05.11	5.832	7.713
507	46.286	18.777	0.559	34.666	13.013	2574140	2480093	5/23/1998	16:27:05.91	5.525	7.713
508	46.269	18.747	0.587	34.676	13.012	2615854	2480015	5/23/1998	16:33:06.71	5.811	7.712
509	46.245	18.723	0.636	34.677	13.013	2580148	2480444	5/23/1998	16:39:07.51	5.566	7.714
510	46.224	18.703	0.695	34.676	13.011	2573582	2480412	5/23/1998	16:45:08.31	5.521	7.714
511	46.195	18.677	0.724	34.673	13.01	2625040	2480393	5/23/1998	16:51:09.11	5.874	7.714
512	46.17	18.644	0.738	34.679	13.01	2541443	2480157	5/23/1998	16:57:09.91	5.300	7.713
513	46.142	18.628	0.786	34.67	13.009	2561447	2480584	5/23/1998	17:03:10.71	5.438	7.715
514	46.117	18.595	0.8	34.676	13.009	2583691	2480850	5/23/1998	17:09:11.51	5.590	7.716
515	46.091	18.564	0.863	34.681	13.008	2580512	2481397	5/23/1998	17:15:12.31	5.569	7.718
516	46.058	18.535	0.869	34.677	13.009	2597700	2481068	5/23/1998	17:21:13.11	5.686	7.717
517	46.018	18.51	0.931	34.665	13.008	2583527	2480458	5/23/1998	17:27:13.91	5.589	7.714
518	45.997	18.473	1.007	34.679	13.006	2583268	2481198	5/23/1998	17:33:14.71	5.587	7.717
519	45.968	18.438	1.004	34.683	13.006	2568334	2481410	5/23/1998	17:39:15.51	5.485	7.718
520	45.936	18.414	1.066	34.676	13.005	2557581	2480883	5/23/1998	17:45:16.31	5.411	7.716
521	45.906	18.378	1.088	34.681	13.006	2606974	2481370	5/23/1998	17:51:17.11	5.750	7.718
522	45.878	18.346	1.107	34.684	13.005	2573104	2481574	5/23/1998	17:57:17.91	5.518	7.719
523	45.851	18.322	1.128	34.682	13.005	2594137	2480791	5/23/1998	18:03:18.71	5.662	7.716
524	45.826	18.286	1.168	34.691	13.004	2583724	2481147	5/23/1998	18:09:19.51	5.591	7.717
525	45.799	18.272	1.214	34.68	13.003	2606361	2481657	5/23/1998	18:15:20.31	5.746	7.719
526	45.78	18.25	1.263	34.683	13.003	2588500	2481590	5/23/1998	18:21:21.11	5.623	7.719
527	45.758	18.226	1.285	34.685	13.004	2527076	2480819	5/23/1998	18:27:21.91	5.202	7.716
528	45.735	18.208	1.332	34.679	13.002	2575497	2481792	5/23/1998	18:33:22.71	5.534	7.720
529	45.714	18.179	1.341	34.687	13.002	2585060	2481844	5/23/1998	18:39:23.51	5.600	7.720
530	45.682	18.147	1.357	34.686	13.002	2549996	2481082	5/23/1998	18:45:24.31	5.359	7.717
531	45.652	18.12	1.384	34.683	13.001	2572520	2481750	5/23/1998	18:51:25.11	5.514	7.720
532	45.623	18.088	1.391	34.686	13.001	2568332	2481663	5/23/1998	18:57:25.91	5.485	7.719
533	45.596	18.056	1.411	34.69	13	2578605	2482370	5/23/1998	19:03:26.71	5.555	7.723
534	45.556	18.021	1.419	34.687	12.999	2538940	2481953	5/23/1998	19:09:27.51	5.283	7.721
535	45.527	17.994	1.468	34.684	13	2541101	2481752	5/23/1998	19:15:28.31	5.298	7.720
536	45.505	17.96	1.491	34.695	12.999	2549788	2482844	5/23/1998	19:21:29.11	5.358	7.725
537	45.473	17.931	1.49	34.692	13.001	2568552	2482291	5/23/1998	19:27:29.91	5.486	7.722
538	45.445	17.905	1.48	34.689	12.998	2536868	2481457	5/23/1998	19:33:30.71	5.269	7.719
539	45.417	17.872	1.482	34.694	12.998	2562550	2482398	5/23/1998	19:39:31.51	5.445	7.723
540	45.396	17.855	1.503	34.69	12.997	2545116	2481969	5/23/1998	19:45:32.31	5.326	7.721
541	45.373	17.832	1.541	34.69	12.996	2532734	2482432	5/23/1998	19:51:33.11	5.241	7.723
542	45.349	17.813	1.501	34.686	12.995	2573317	2481901	5/23/1998	19:57:33.91	5.519	7.721
543	45.334	17.782	1.504	34.699	12.995	2503493	2482177	5/23/1998	20:03:34.71	5.040	7.722
544	45.316	17.772	1.465	34.692	12.997	2541711	2482256	5/23/1998	20:09:35.51	5.302	7.722
545	45.301	17.746	1.485	34.702	12.995	2549164	2482774	5/23/1998	20:15:36.31	5.353	7.724
546	45.288	17.734	1.472	34.701	12.995	2573047	2482208	5/23/1998	20:21:37.11	5.517	7.722
547	45.271	17.719	1.425	34.699	12.996	2545708	2482614	5/23/1998	20:27:37.91	5.330	7.724
548	45.255	17.706	1.423	34.697	12.996	2542285	2481805	5/23/1998	20:33:38.71	5.306	7.720
549	45.242	17.686	1.428	34.702	12.993	2550228	2482247	5/23/1998	20:39:39.51	5.361	7.722
550	45.23	17.673	1.414	34.703	12.995	2581937	2482300	5/23/1998	20:45:40.31	5.578	7.722
551	45.211	17.66	1.399	34.698	12.993	2570273	2481932	5/23/1998	20:51:41.11	5.498	7.721
552	45.199	17.646	1.37	34.699	12.993	2549604	2482879	5/23/1998	20:57:41.91	5.356	7.725
553	45.187	17.626	1.305	34.707	12.993	2541774	2482251	5/23/1998	21:03:42.71	5.303	7.722
554	45.176	17.619	1.312	34.704	12.992	2572604	2481994	5/23/1998	21:09:43.51	5.514	7.721
555	45.163	17.621	1.295	34.69	12.992	2533328	2483003	5/23/1998	21:15:44.31	5.245	7.725
556	45.16	17.593	1.264	34.712	12.992	2553867	2482282	5/23/1998	21:21:45.11	5.386	7.722
557	45.145	17.589	1.224	34.702	12.991	2528496	2482018	5/23/1998	21:27:45.91	5.212	7.721
558	45.143	17.577	1.18	34.711	12.991	2573246	2482777	5/23/1998	21:33:46.71	5.519	7.724
559	45.136	17.58	1.162	34.701	12.99	2543755	2482861	5/23/1998	21:39:47.51	5.316	7.725
560	45.126	17.566	1.103	34.705	12.992	2524751	2482836	5/23/1998	21:45:48.31	5.186	7.725
561	45.117	17.563	1.052	34.701	12.991	2586559	2482209	5/23/1998	21:51:49.11	5.610	7.722
562	45.115	17.561	0.987	34.701	12.99	2567427	2482785	5/23/1998	21:58:31.19	5.479	7.724
563	45.107	17.553	0.969	34.7	12.99	2506946	2483473	5/23/1998	22:04:31.99	5.064	7.727
564	45.105	17.541	0.908	34.708	12.99	2570293	2482717	5/23/1998	22:10:32.79	5.498	7.724
565	45.101	17.544	0.87	34.703	12.989	2520401	2483099	5/23/1998	22:16:33.59	5.156	7.726
566	45.1	17.542	0.835	34.703	12.989	2560565	2483233	5/23/1998	22:22:34.39	5.432	7.726
567	45.092	17.531	0.776	34.706	12.988	2564660	2482768	5/23/1998	22:28:35.19	5.460	7.724
568	45.087	17.524	0.757	34.707	12.989	2591988	2482636	5/23/1998	22:34:35.99	5.647	7.724
569	45.089	17.524	0.681	34.709	12.99	2564991	2482864	5/23/1998	22:40:36.79	5.462	7.725
570	45.08	17.525	0.635	34.701	12.989	2563840	2482469	5/23/1998	22:46:37.59	5.454	7.723
571	45.087	17.531	0.563	34.701	12.989	2557546	2482790	5/23/1998	22:52:38.39	5.411	7.724
572	45.081	17.521	0.523	34.705	12.989	2554226	2482937	5/23/1998	22:58:39.19	5.388	7.725
573	45.086	17.519	0.499	34.711	12.989	2555007	2483189	5/23/1998	23:04:39.99	5.393	7.726
574	45.086	17.513	0.412	34.716	12.988	2556514	2483846	5/23/1998	23:10:40.79	5.404	7.729
575	45.079	17.52	0.366	34.705	12.989	2543696	2483116	5/23/1998	23:16:41.59	5.316	7.726
576	45.086	17.522	0.31	34.709	12.988	2558715	2482789	5/23/1998	23:22:42.39	5.419	7.724
577	45.093	17.527	0.286	34.71	12.989	2522378	2483076	5/23/1998	23:28:43.19	5.170	7.726
578	45.101	17.534	0.256	34.711	12.988	2547002	2483104	5/23/1998	23:34:43.99	5.339	7.726
579	45.108	17.543	0.198	34.71	12.988	2523847	2482955	5/23/1998	23:40:44.79	5.180	7.725
580	45.105	17.537	0.128	34.712	12.987	2558518	2483796	5/23/1998	23:46:45.59	5.418	7.729
581	45.115	17.556	0.086	34.705	12.986	2556187	2483044	5/23/1998	23:52:46.39	5.402	7.725

Record No.	Conductivity (mS/cm)	Temperature (Deg. C)	Pressure (dBar)	Salinity (PSU)	CTD Bat. (Vdc)	D.O. (Integer)	pH (Integer)	Date	Time	D.O. (ml/L)	pH (Value)
582	45.129	17.566	0.03	34.709	12.987	2500909	2483400	5/23/1998	23:58:47.19	5.022	7.727
583	45.137	17.573	-0.008	34.709	12.987	2540087	2483205	5/24/1998	00:04:47.99	5.291	7.726
584	45.142	17.589	-0.057	34.7	12.987	2557522	2482857	5/24/1998	00:10:48.79	5.411	7.725
585	45.156	17.586	-0.112	34.715	12.988	2544295	2483388	5/24/1998	00:16:49.59	5.320	7.727
586	45.164	17.595	-0.152	34.714	12.986	2512824	2483547	5/24/1998	00:22:50.39	5.104	7.728
587	45.172	17.609	-0.208	34.709	12.986	2583169	2483441	5/24/1998	00:28:51.19	5.587	7.727
588	45.202	17.638	-0.239	34.71	12.986	2545343	2483371	5/24/1998	00:34:51.99	5.327	7.727
589	45.221	17.66	-0.313	34.707	12.986	2567448	2483139	5/24/1998	00:40:52.79	5.479	7.726
590	45.251	17.683	-0.336	34.714	12.987	2542378	2483583	5/24/1998	00:46:53.59	5.307	7.728
591	45.279	17.717	-0.372	34.708	12.988	2565647	2483039	5/24/1998	00:52:54.39	5.466	7.725
592	45.318	17.75	-0.389	34.713	12.988	2528270	2483811	5/24/1998	00:58:55.19	5.210	7.729
593	45.352	17.784	-0.422	34.714	12.989	2553815	2483501	5/24/1998	01:04:55.99	5.385	7.727
594	45.39	17.828	-0.459	34.709	12.988	2547765	2483306	5/24/1998	01:10:56.79	5.344	7.727
595	45.436	17.887	-0.478	34.698	12.988	2570320	2483246	5/24/1998	01:16:57.59	5.499	7.726
596	45.487	17.922	-0.506	34.712	12.989	2580803	2483211	5/24/1998	01:22:58.39	5.571	7.726
597	45.529	17.966	-0.523	34.71	12.99	2568912	2483041	5/24/1998	01:28:59.19	5.489	7.725
598	45.581	18.024	-0.573	34.705	12.99	2533323	2482691	5/24/1998	01:34:59.99	5.245	7.724
599	45.616	18.063	-0.605	34.702	12.99	2595121	2482810	5/24/1998	01:41:00.79	5.669	7.724
600	45.664	18.1	-0.635	34.712	12.99	2546168	2482842	5/24/1998	01:47:01.59	5.333	7.725
601	45.711	18.159	-0.648	34.702	12.991	2534781	2482967	5/24/1998	01:53:02.39	5.255	7.725
602	45.748	18.192	-0.665	34.706	12.992	2552269	2483090	5/24/1998	01:59:03.19	5.375	7.726
603	45.786	18.235	-0.701	34.701	12.99	2568990	2482724	5/24/1998	02:05:03.99	5.489	7.724
604	45.82	18.298	-0.684	34.676	12.991	2525259	2482959	5/24/1998	02:11:04.79	5.189	7.725
605	45.854	18.311	-0.714	34.694	12.991	2538785	2483365	5/24/1998	02:17:05.59	5.282	7.727
606	45.893	18.344	-0.699	34.699	12.989	2567812	2483468	5/24/1998	02:23:06.39	5.481	7.727
607	45.935	18.391	-0.725	34.695	12.99	2541899	2483093	5/24/1998	02:29:07.19	5.304	7.726
608	45.964	18.42	-0.719	34.695	12.992	2540393	2482727	5/24/1998	02:35:07.99	5.293	7.724
609	45.992	18.449	-0.739	34.695	12.991	2540277	2482763	5/24/1998	02:41:08.79	5.292	7.724
610	46.023	18.474	-0.73	34.7	12.993	2537097	2482703	5/24/1998	02:47:09.59	5.271	7.724
611	46.043	18.493	-0.754	34.701	12.992	2576601	2482464	5/24/1998	02:53:10.39	5.542	7.723
612	46.068	18.519	-0.751	34.699	12.992	2558954	2482937	5/24/1998	02:59:11.19	5.421	7.725
613	46.088	18.542	-0.737	34.697	12.991	2541793	2481986	5/24/1998	03:05:11.99	5.303	7.721
614	46.115	18.572	-0.723	34.695	12.992	2587505	2482243	5/24/1998	03:11:12.79	5.616	7.722
615	46.146	18.592	-0.715	34.704	12.993	2575389	2482031	5/24/1998	03:17:13.59	5.533	7.721
616	46.166	18.627	-0.71	34.692	12.991	2563601	2483049	5/24/1998	03:23:14.39	5.452	7.725
617	46.191	18.654	-0.686	34.689	12.991	2577697	2481794	5/24/1998	03:29:15.19	5.549	7.720
618	46.219	18.675	-0.661	34.696	12.99	2537695	2482100	5/24/1998	03:35:15.99	5.275	7.721
619	46.245	18.706	-0.645	34.692	12.992	2545402	2482519	5/24/1998	03:41:16.79	5.328	7.723
620	46.269	18.737	-0.62	34.685	12.991	2536966	2482121	5/24/1998	03:47:17.59	5.270	7.721
621	46.296	18.754	-0.594	34.694	12.99	2579232	2482448	5/24/1998	03:53:18.39	5.560	7.723
622	46.316	18.782	-0.555	34.687	12.99	2520219	2482138	5/24/1998	03:59:19.19	5.155	7.722
623	46.346	18.798	-0.519	34.699	12.991	2569504	2482001	5/24/1998	04:05:19.99	5.493	7.721
624	46.376	18.836	-0.49	34.692	12.991	2581072	2481781	5/24/1998	04:11:20.79	5.572	7.720
625	46.397	18.861	-0.465	34.688	12.991	2533552	2481614	5/24/1998	04:17:21.59	5.246	7.719
626	46.421	18.884	-0.448	34.689	12.991	2596221	2481413	5/24/1998	04:23:22.39	5.676	7.718
627	46.437	18.902	-0.44	34.687	12.991	2538500	2481251	5/24/1998	04:29:23.19	5.280	7.718
628	46.461	18.928	-0.391	34.686	12.991	2604953	2481362	5/24/1998	04:35:23.99	5.736	7.718
629	46.476	18.945	-0.366	34.685	12.991	2585740	2481356	5/24/1998	04:41:24.79	5.604	7.718
630	46.491	18.959	-0.308	34.686	12.99	2567337	2481101	5/24/1998	04:47:25.59	5.478	7.717
631	46.513	18.978	-0.275	34.687	12.99	2529637	2480978	5/24/1998	04:53:26.39	5.219	7.717
632	46.526	18.992	-0.233	34.687	12.99	2543221	2480621	5/24/1998	05:00:08.47	5.313	7.715
633	46.538	19.008	-0.19	34.684	12.989	2592995	2480589	5/24/1998	05:06:09.27	5.654	7.715
634	46.553	19.021	-0.14	34.686	12.992	2569245	2481033	5/24/1998	05:12:10.07	5.491	7.717
635	46.562	19.033	-0.097	34.683	12.989	2547902	2480931	5/24/1998	05:18:10.87	5.345	7.716
636	46.567	19.04	-0.081	34.68	12.99	2574859	2481231	5/24/1998	05:24:11.67	5.530	7.718
637	46.572	19.043	-0.044	34.683	12.989	2567125	2480746	5/24/1998	05:30:12.47	5.477	7.716
638	46.561	19.035	0	34.679	12.99	2540199	2480925	5/24/1998	05:36:13.27	5.292	7.716
639	46.555	19.02	0.045	34.687	12.989	2593297	2481167	5/24/1998	05:42:14.07	5.656	7.717
640	46.537	19.019	0.046	34.673	12.989	2541115	2481025	5/24/1998	05:48:14.87	5.298	7.717
641	46.535	18.995	0.088	34.692	12.99	2588694	2480306	5/24/1998	05:54:15.67	5.625	7.714
642	46.519	18.987	0.133	34.685	12.989	2581442	2480319	5/24/1998	06:00:16.47	5.575	7.714
643	46.495	18.971	0.179	34.679	12.988	2556843	2480428	5/24/1998	06:06:17.27	5.406	7.714
644	46.484	18.949	0.202	34.687	12.99	2623828	2480374	5/24/1998	06:12:18.07	5.866	7.714
645	46.463	18.928	0.247	34.687	12.988	2553731	2480736	5/24/1998	06:18:18.87	5.385	7.715
646	46.444	18.913	0.293	34.684	12.988	2598748	2480040	5/24/1998	06:24:19.67	5.694	7.712
647	46.422	18.889	0.331	34.686	12.989	2534929	2480518	5/24/1998	06:30:20.47	5.256	7.715
648	46.393	18.863	0.384	34.684	12.986	2568590	2480127	5/24/1998	06:36:21.27	5.487	7.713
649	46.37	18.836	0.396	34.686	12.984	2591569	2480807	5/24/1998	06:42:22.07	5.644	7.716
650	46.35	18.811	0.414	34.69	12.985	2518750	2480723	5/24/1998	06:48:22.87	5.145	7.715
651	46.326	18.788	0.445	34.69	12.986	2569182	2480286	5/24/1998	06:54:23.67	5.491	7.714
652	46.296	18.758	0.497	34.69	12.984	2589712	2479956	5/24/1998	07:00:24.47	5.632	7.712
653	46.264	18.727	0.528	34.69	12.985	2615226	2480044	5/24/1998	07:06:25.27	5.807	7.712
654	46.236	18.698	0.531	34.69	12.982	2577135	2481169	5/24/1998	07:12:26.07	5.545	7.717
655	46.212	18.67	0.545	34.693	12.982	2546537	2479903	5/24/1998	07:18:26.87	5.335	7.712
656	46.189	18.648	0.578	34.692	12.982	2577851	2479914	5/24/1998	07:24:27.67	5.550	7.712
657	46.163	18.623	0.64	34.692	12.981	2569404	2480390	5/24/1998	07:30:28.47	5.492	7.714
658	46.138	18.582	0.691	34.705	12.981	2548668	2479683	5/24/1998	07:36:29.27	5.350	7.711
659	46.114	18.568	0.676	34.696	12.981	2599476	2480805	5/24/1998	07:42:30.07	5.699	7.716
660	46.093	18.556	0.68	34.689	12.98	2584971	2480287	5/24/1998	07:48:30.87	5.599	7.714
661	46.075	18.535	0.735	34.692	12.981	2552176	2481159	5/24/1998	07:54:31.67	5.374	7.717
662	46.057	18.508	0.76	34.699	12.98	2577478	2479673	5/24/1998	08:00:32.47	5.548	7.711
663	46.037	18.492	0.73	34.696	12.981	2512271	2480312	5/24/1998	08:06:33.27	5.100	7.714
664	46.016	18.475	0.759	34.692	12.979	2561416	2480509	5/24/1998	08:12:34.07	5.437	7.714
665	45.983	18.437	0.784	34.696	12.978	2587310	2479662	5/24/1998	08:18:34.87	5.615	7.711
666	45.957	18.41	0.804	34.697	12.979	2524612	2480053	5/24/1998	08:24:35.67	5.185	7.713
667	45.93	18.384	0.833	34.697	12.977	2547238	2480214	5/24/1998	08:30:36.47	5.340	7.713
668	45.898	18.349	0.809	34.7	12.978	2509149	2479837	5/24/1998	08:36:37.27	5.079	7.712
669	45.873	18.317	0.808	34.704	12.977	2499807	2480035	5/24/1998	08:42:38.07	5.015	7.712
670	45.848	18.295	0.817	34.702	12.978	2586391	2479196	5/24/1998	08:48:38.87	5.609	7.709
671	45.813	18.271	0.821	34.693	12.976	2545989	2479758	5/24/1998	08:54:39.67	5.332	7.711
672	45.801	18.252	0.798	34.699	12.976	2531883	2479912	5/24/1998	09:00:40.47	5.235	7.712
673	45.774	18.224	0.81	34.7	12.975	2552643	2479717	5/24/1998	09:06:41.27	5.377	7.711
674	45.759	18.21	0.843	34.698	12.975	2570936	2479692	5/24/1998	09:12:42.07	5.503	7.711
675	45.744	18.187	0.814	34.706	12.977	2548121	2479790	5/24/1998	09:18:42.87	5.346	7.711

Record No.	Conductivity (mS/cm)	Temperature (Deg. C)	Pressure (dBar)	Salinity (PSU)	CTD Bat. (Vdc)	D.O. (Integer)	pH (Integer)	Date	Time	D.O. (ml/L)	pH (Value)
676	45.736	18.176	0.823	34.708	12.975	2528995	2479496	5/24/1998	09:24:43.67	5.215	7.710
677	45.718	18.159	0.81	34.707	12.974	2532611	2480202	5/24/1998	09:30:44.47	5.240	7.713
678	45.708	18.152	0.753	34.704	12.975	2540490	2479465	5/24/1998	09:36:45.27	5.294	7.710
679	45.696	18.149	0.708	34.697	12.974	2560060	2479524	5/24/1998	09:42:46.07	5.428	7.710
680	45.692	18.132	0.723	34.708	12.973	2560181	2480266	5/24/1998	09:48:46.87	5.429	7.713
681	45.68	18.116	0.698	34.711	12.974	2537599	2479712	5/24/1998	09:54:47.67	5.274	7.711
682	45.663	18.103	0.657	34.708	12.972	2538305	2479775	5/24/1998	10:00:48.47	5.279	7.711
683	45.65	18.086	0.651	34.711	12.972	2526122	2480495	5/24/1998	10:06:49.27	5.195	7.714
684	45.634	18.066	0.649	34.715	12.971	2537052	2480465	5/24/1998	10:12:50.07	5.270	7.714
685	45.621	18.07	0.662	34.7	12.971	2571463	2480276	5/24/1998	10:18:50.87	5.506	7.713
686	45.609	18.046	0.567	34.71	12.97	2570091	2479485	5/24/1998	10:24:51.67	5.497	7.710
687	45.594	18.032	0.55	34.709	12.97	2576956	2480144	5/24/1998	10:30:52.47	5.544	7.713
688	45.585	18.024	0.512	34.708	12.97	2549565	2479847	5/24/1998	10:36:53.27	5.356	7.712
689	45.581	18.02	0.509	34.709	12.969	2540772	2480086	5/24/1998	10:42:54.07	5.296	7.713
690	45.574	18.019	0.486	34.704	12.97	2560019	2479711	5/24/1998	10:48:54.87	5.428	7.711
691	45.568	18.008	0.424	34.708	12.968	2561840	2479781	5/24/1998	10:54:55.67	5.440	7.711
692	45.559	17.995	0.402	34.711	12.968	2553935	2479301	5/24/1998	11:00:56.47	5.386	7.709
693	45.553	17.997	0.371	34.704	12.966	2555828	2479552	5/24/1998	11:06:57.27	5.399	7.710
694	45.554	17.994	0.331	34.708	12.968	2525852	2479064	5/24/1998	11:12:58.07	5.193	7.708
695	45.542	17.984	0.284	34.706	12.969	2558633	2479656	5/24/1998	11:18:58.87	5.418	7.711
696	45.546	17.99	0.252	34.704	12.969	2534397	2478554	5/24/1998	11:24:59.67	5.252	7.706
697	45.534	17.988	0.244	34.696	12.969	2550951	2479299	5/24/1998	11:31:00.47	5.366	7.709
698	45.538	17.981	0.211	34.705	12.97	2564371	2478272	5/24/1998	11:37:01.27	5.458	7.705
699	45.552	17.989	0.191	34.71	12.969	2540574	2479039	5/24/1998	11:43:02.07	5.294	7.708
700	45.557	17.999	0.135	34.706	12.968	2549046	2479188	5/24/1998	11:49:02.87	5.353	7.709
701	45.573	18.008	0.124	34.711	12.969	2521176	2478542	5/24/1998	11:55:03.67	5.161	7.706

Blank Test #3 Sensor Data

Record No.	Conductivity (mS/cm)	Temperature (Deg. C)	Pressure (dBar)	Salinity (PSU)	CTD Bat. (Vdc)	D.O. (Integer)	pH (Integer)	Date	Time	D.O. (ml/L)	pH (Value)
1	45.815	18.716	1.364	34.32	13.006	2290723	2452020	5/28/1998	09:28:05.56	3.580	7.591
2	45.925	18.688	1.382	34.436	13.015	2223053	2462045	5/28/1998	09:34:47.56	3.115	7.635
3	45.99	18.683	1.404	34.495	12.967	2293106	2465218	5/28/1998	09:40:48.37	3.596	7.648
4	46.056	18.669	1.456	34.563	13.001	2236476	2466725	5/28/1998	09:46:49.16	3.207	7.655
5	46.083	18.653	1.469	34.598	13.01	2238362	2467832	5/28/1998	09:52:49.96	3.220	7.660
6	46.096	18.634	1.486	34.626	13.016	2245414	2469430	5/28/1998	09:58:50.76	3.269	7.667
7	46.113	18.621	1.497	34.651	13.017	2206619	2469853	5/28/1998	10:04:51.56	3.002	7.668
8	46.12	18.609	1.537	34.667	13.02	2186797	2470326	5/28/1998	10:10:52.36	2.866	7.670
9	46.109	18.59	1.566	34.673	13.019	2213549	2470326	5/28/1998	10:16:53.16	3.050	7.670
10	46.093	18.569	1.616	34.678	13.02	2222627	2472133	5/28/1998	10:22:53.96	3.112	7.678
11	46.071	18.52	1.666	34.7	13.019	2158621	2472106	5/28/1998	10:28:54.76	2.673	7.678
12	46.028	18.485	1.627	34.694	13.018	2229338	2472252	5/28/1998	10:34:55.56	3.158	7.679
13	45.974	18.431	1.63	34.694	13.017	2273754	2472350	5/28/1998	10:40:56.36	3.463	7.679
14	45.909	18.363	1.691	34.696	13.016	2257372	2473658	5/28/1998	10:46:57.16	3.351	7.685
15	45.844	18.287	1.698	34.706	13.014	2232544	2473818	5/28/1998	10:52:57.96	3.180	7.686
16	45.787	18.235	1.734	34.702	13.014	2205787	2474933	5/28/1998	10:58:58.76	2.997	7.690
17	45.729	18.165	1.798	34.711	13.013	2207467	2474394	5/28/1998	11:04:59.56	3.008	7.688
18	45.668	18.097	1.792	34.717	13.011	2206701	2474872	5/28/1998	11:11:00.36	3.003	7.690
19	45.612	18.033	1.824	34.723	13.01	2154618	2474108	5/28/1998	11:17:01.16	2.646	7.687
20	45.552	17.966	1.816	34.729	13.008	2156546	2474537	5/28/1998	11:23:01.96	2.659	7.689
21	45.485	17.906	1.871	34.723	13.007	2302887	2474953	5/28/1998	11:29:02.76	3.663	7.690
22	45.426	17.855	1.867	34.716	13.007	2175133	2474923	5/28/1998	11:35:03.56	2.786	7.690
23	45.397	17.813	1.852	34.727	13.005	2151673	2475793	5/28/1998	11:41:04.36	2.625	7.694
24	45.341	17.76	1.816	34.724	13.005	2195048	2475315	5/28/1998	11:47:05.16	2.923	7.692
25	45.287	17.701	1.878	34.728	13.003	2170562	2475311	5/28/1998	11:53:05.96	2.755	7.692
26	45.254	17.669	1.904	34.727	13.002	2224754	2475966	5/28/1998	11:59:06.76	3.127	7.695
27	45.225	17.63	1.949	34.735	13.002	2236781	2476073	5/28/1998	12:05:07.56	3.209	7.695
28	45.188	17.592	1.943	34.736	13.001	2171152	2476342	5/28/1998	12:11:08.36	2.759	7.696
29	45.153	17.555	1.931	34.738	12.999	2205415	2476254	5/28/1998	12:17:09.16	2.994	7.696
30	45.123	17.529	1.964	34.734	12.999	2192285	2476613	5/28/1998	12:23:09.96	2.904	7.698
31	45.088	17.492	1.883	34.736	12.998	2176514	2476551	5/28/1998	12:29:10.76	2.796	7.697
32	45.061	17.464	1.939	34.736	12.998	2197530	2476934	5/28/1998	12:35:11.56	2.940	7.699
33	45.022	17.429	1.936	34.733	12.997	2210250	2477219	5/28/1998	12:41:12.36	3.027	7.700
34	44.997	17.399	1.902	34.737	12.997	2167761	2477830	5/28/1998	12:47:13.16	2.736	7.703
35	44.97	17.373	1.927	34.736	12.994	2240925	2477797	5/28/1998	12:53:13.96	3.238	7.703
36	44.932	17.331	1.882	34.739	12.994	2208959	2476901	5/28/1998	12:59:14.76	3.019	7.699
37	44.902	17.294	1.879	34.745	12.994	2183254	2477105	5/28/1998	13:05:15.56	2.842	7.700
38	44.863	17.275	1.85	34.728	12.991	2211296	2477412	5/28/1998	13:11:16.36	3.035	7.701
39	44.834	17.225	1.855	34.745	12.991	2191683	2477101	5/28/1998	13:17:17.16	2.900	7.700
40	44.786	17.171	1.821	34.75	12.99	2185387	2478957	5/28/1998	13:23:17.96	2.857	7.708
41	44.744	17.134	1.823	34.745	12.989	2270538	2478453	5/28/1998	13:29:18.76	3.441	7.706
42	44.717	17.112	1.785	34.741	12.989	2226386	2477935	5/28/1998	13:35:19.56	3.138	7.703
43	44.697	17.081	1.784	34.75	12.987	2287064	2478254	5/28/1998	13:41:20.36	3.555	7.705
44	44.679	17.066	1.803	34.747	12.99	2167817	2478587	5/28/1998	13:47:21.16	2.736	7.706
45	44.663	17.048	1.768	34.75	12.987	2231016	2478824	5/28/1998	13:53:21.96	3.170	7.707
46	44.658	17.034	1.769	34.756	12.987	2184851	2478275	5/28/1998	13:59:22.76	2.853	7.705
47	44.635	17.02	1.706	34.749	12.986	2225184	2478505	5/28/1998	14:05:23.56	3.130	7.706
48	44.616	16.991	1.698	34.758	12.985	2280386	2479179	5/28/1998	14:11:24.36	3.509	7.709
49	44.596	16.98	1.716	34.75	12.984	2169856	2478613	5/28/1998	14:17:25.16	2.750	7.706
50	44.576	16.963	1.652	34.747	12.984	2181731	2480505	5/28/1998	14:23:25.96	2.832	7.714
51	44.558	16.937	1.638	34.754	12.985	2296427	2478729	5/28/1998	14:29:26.76	3.619	7.707
52	44.535	16.933	1.61	34.738	12.983	2169892	2478429	5/28/1998	14:35:27.56	2.750	7.706
53	44.531	16.923	1.6	34.742	12.983	2253349	2479582	5/28/1998	14:41:28.36	3.323	7.710
54	44.533	16.918	1.581	34.748	12.982	2256639	2479462	5/28/1998	14:47:29.16	3.346	7.710
55	44.528	16.908	1.557	34.753	12.981	2226991	2480557	5/28/1998	14:53:29.96	3.142	7.715
56	44.518	16.899	1.571	34.752	12.983	2241897	2480650	5/28/1998	14:59:30.76	3.245	7.715
57	44.527	16.915	1.504	34.745	12.958	2316993	2480476	5/28/1998	15:05:31.56	3.760	7.714
58	44.549	16.925	1.489	34.756	12.969	2308439	2480391	5/28/1998	15:11:32.36	3.701	7.714
59	44.571	16.949	1.482	34.754	12.974	2298706	2479076	5/28/1998	15:17:33.16	3.634	7.708
60	44.584	16.968	1.454	34.75	12.975	2188520	2480158	5/28/1998	15:23:33.96	2.878	7.713
61	44.611	16.993	1.49	34.751	12.976	2281052	2480822	5/28/1998	15:29:34.76	3.513	7.716

Record No.	Conductivity (mS/cm)	Temperature (Deg. C)	Pressure (dBar)	Salinity (PSU)	CTD Bat. (Vdc)	D.O. (Integer)	pH (Integer)	Date	Time	D.O. (ml/L)	pH (Value)
62	44.652	17.032	1.461	34.753	12.977	2232378	2480235	5/28/1998	15:35:35.56	3.179	7.713
63	44.698	17.07	1.431	34.76	12.977	2227837	2481468	5/28/1998	15:41:36.36	3.148	7.719
64	44.732	17.124	1.423	34.744	12.978	2310947	2481383	5/28/1998	15:47:37.16	3.718	7.718
65	44.76	17.135	1.393	34.759	12.978	2269562	2481657	5/28/1998	15:53:37.96	3.434	7.719
66	44.793	17.184	1.387	34.745	12.978	2142602	2481480	5/28/1998	15:59:38.76	2.563	7.719
67	44.836	17.218	1.397	34.753	12.978	2359776	2481416	5/28/1998	16:05:39.56	4.054	7.718
68	44.885	17.26	1.37	34.759	12.978	2187769	2481843	5/28/1998	16:11:40.36	2.873	7.720
69	44.938	17.327	1.325	34.748	12.98	2264049	2481391	5/28/1998	16:17:41.16	3.397	7.718
70	44.979	17.371	1.32	34.745	12.98	2257395	2483061	5/28/1998	16:23:41.96	3.351	7.726
71	45.027	17.412	1.361	34.752	12.979	2255995	2483105	5/28/1998	16:29:42.76	3.341	7.726
72	45.075	17.466	1.344	34.747	12.978	2179090	2482225	5/28/1998	16:36:24.77	2.814	7.722
73	45.12	17.505	1.357	34.752	12.979	2306360	2482959	5/28/1998	16:42:25.57	3.687	7.725
74	45.163	17.553	1.318	34.748	12.98	2216848	2482842	5/28/1998	16:48:26.37	3.073	7.725
75	45.206	17.602	1.312	34.743	12.982	2299811	2483179	5/28/1998	16:54:27.17	3.642	7.726
76	45.248	17.647	1.346	34.741	12.978	2347777	2482750	5/28/1998	17:00:27.97	3.971	7.724
77	45.294	17.686	1.295	34.747	12.979	2270299	2483758	5/28/1998	17:06:28.77	3.440	7.729
78	45.341	17.736	1.28	34.745	12.979	2326224	2483566	5/28/1998	17:12:29.57	3.823	7.728
79	45.379	17.773	1.276	34.746	12.978	2330116	2483555	5/28/1998	17:18:30.37	3.850	7.728
80	45.411	17.809	1.258	34.743	12.979	2194439	2484385	5/28/1998	17:24:31.17	2.919	7.731
81	45.44	17.832	1.294	34.748	12.977	2257972	2484310	5/28/1998	17:30:31.97	3.355	7.731
82	45.455	17.862	1.269	34.735	12.979	2273135	2484298	5/28/1998	17:36:32.77	3.459	7.731
83	45.47	17.867	1.276	34.744	12.977	2226056	2484261	5/28/1998	17:42:33.57	3.136	7.731
84	45.503	17.894	1.251	34.749	12.976	2264866	2484409	5/28/1998	17:48:34.37	3.402	7.731
85	45.524	17.918	1.303	34.746	12.974	2191887	2485034	5/28/1998	17:54:35.17	2.901	7.734
86	45.537	17.94	1.311	34.739	12.975	2206129	2484422	5/28/1998	18:00:35.97	2.999	7.731
87	45.551	17.949	1.279	34.743	12.974	2305341	2484806	5/28/1998	18:06:36.77	3.680	7.733
88	45.57	17.957	1.311	34.752	12.975	2331995	2485314	5/28/1998	18:12:37.57	3.863	7.735
89	45.578	17.982	1.308	34.738	12.976	2260783	2485226	5/28/1998	18:18:38.37	3.374	7.735
90	45.588	17.987	1.31	34.742	12.975	2344333	2485342	5/28/1998	18:24:39.17	3.948	7.735
91	45.599	17.997	1.345	34.743	12.975	2346424	2485206	5/28/1998	18:30:39.97	3.962	7.735
92	45.597	17.996	1.348	34.742	12.973	2196651	2485632	5/28/1998	18:36:40.77	2.934	7.737
93	45.598	17.996	1.324	34.744	12.972	2296295	2485061	5/28/1998	18:42:41.57	3.618	7.734
94	45.607	18.002	1.336	34.746	12.972	2319592	2485361	5/28/1998	18:48:42.37	3.778	7.735
95	45.613	17.996	1.325	34.756	12.97	2243620	2486595	5/28/1998	18:54:43.17	3.256	7.741
96	45.604	18	1.376	34.745	12.968	2275180	2486285	5/28/1998	19:00:43.97	3.473	7.739
97	45.592	17.994	1.381	34.74	12.969	2370584	2486850	5/28/1998	19:06:44.77	4.128	7.742
98	45.579	17.97	1.459	34.749	12.967	2337242	2487006	5/28/1998	19:12:45.57	3.899	7.743
99	45.571	17.962	1.459	34.749	12.969	2324875	2486095	5/28/1998	19:18:46.37	3.814	7.739
100	45.549	17.947	1.538	34.743	12.969	2238043	2486748	5/28/1998	19:24:47.17	3.218	7.741
101	45.53	17.929	1.519	34.742	12.962	2223320	2486805	5/28/1998	19:30:47.97	3.117	7.742
102	45.515	17.902	1.518	34.752	12.962	2278924	2486859	5/28/1998	19:36:48.77	3.499	7.742
103	45.5	17.888	1.515	34.751	12.964	2348339	2487286	5/28/1998	19:42:49.57	3.975	7.744
104	45.489	17.873	1.542	34.755	12.966	2312372	2487225	5/28/1998	19:48:50.37	3.728	7.744
105	45.478	17.865	1.587	34.752	12.967	2254922	2486864	5/28/1998	19:54:51.17	3.334	7.742
106	45.448	17.844	1.594	34.745	12.966	2314330	2486693	5/28/1998	20:00:51.97	3.742	7.741
107	45.425	17.817	1.618	34.748	12.967	2387819	2487259	5/28/1998	20:06:52.77	4.246	7.744
108	45.403	17.792	1.62	34.75	12.966	2296862	2486566	5/28/1998	20:12:53.57	3.622	7.741
109	45.37	17.763	1.68	34.747	12.965	2339111	2486866	5/28/1998	20:18:54.37	3.912	7.742
110	45.341	17.729	1.736	34.751	12.966	2329803	2486786	5/28/1998	20:24:55.17	3.848	7.742
111	45.294	17.679	1.705	34.753	12.964	2358646	2487401	5/28/1998	20:30:55.97	4.046	7.744
112	45.264	17.654	1.731	34.748	12.965	2330498	2487117	5/28/1998	20:36:56.77	3.853	7.743
113	45.214	17.594	1.786	34.757	12.963	2314874	2487420	5/28/1998	20:42:57.57	3.745	7.744
114	45.168	17.555	1.775	34.751	12.962	2308275	2487907	5/28/1998	20:48:58.37	3.700	7.746
115	45.116	17.505	1.811	34.748	12.962	2344272	2487680	5/28/1998	20:54:59.17	3.947	7.745
116	45.073	17.457	1.837	34.753	12.961	2317267	2487876	5/28/1998	21:00:59.97	3.762	7.746
117	45.029	17.413	1.858	34.752	12.963	2300178	2487405	5/28/1998	21:07:00.77	3.645	7.744
118	44.99	17.358	1.924	34.766	12.96	2331624	2488023	5/28/1998	21:13:01.57	3.860	7.747
119	44.958	17.33	1.878	34.762	12.96	2329359	2487137	5/28/1998	21:19:02.37	3.845	7.743
120	44.915	17.294	1.953	34.757	12.959	2262493	2488073	5/28/1998	21:25:03.17	3.386	7.747
121	44.881	17.258	1.938	34.757	12.959	2240792	2488232	5/28/1998	21:31:03.97	3.237	7.748
122	44.846	17.223	1.958	34.757	12.958	2298574	2488113	5/28/1998	21:37:04.77	3.634	7.747
123	44.809	17.183	1.98	34.76	12.957	2262848	2488095	5/28/1998	21:43:05.57	3.388	7.747
124	44.778	17.139	1.945	34.771	12.957	2331855	2487752	5/28/1998	21:49:06.37	3.862	7.746
125	44.744	17.119	2.03	34.758	12.956	2280193	2488258	5/28/1998	21:55:07.17	3.507	7.748
126	44.708	17.078	2.065	34.762	12.955	2294880	2487701	5/28/1998	22:01:07.97	3.608	7.746
127	44.681	17.045	2.079	34.768	12.955	2308214	2488757	5/28/1998	22:07:08.77	3.700	7.750
128	44.664	17.005	2.063	34.787	12.955	2315095	2487847	5/28/1998	22:13:09.57	3.747	7.746
129	44.651	17.013	2.068	34.769	12.955	2289608	2487275	5/28/1998	22:19:10.37	3.572	7.744
130	44.617	16.977	2.087	34.771	12.953	2297307	2488295	5/28/1998	22:25:11.17	3.625	7.748
131	44.597	16.964	2.123	34.764	12.952	2336293	2487711	5/28/1998	22:31:11.97	3.892	7.746
132	44.581	16.941	2.11	34.77	12.953	2304030	2487121	5/28/1998	22:37:12.77	3.671	7.743
133	44.558	16.922	2.155	34.767	12.951	2351956	2487332	5/28/1998	22:43:13.57	4.000	7.744
134	44.525	16.881	2.177	34.773	12.951	2328506	2488363	5/28/1998	22:49:14.37	3.839	7.748
135	44.519	16.867	2.184	34.78	12.952	2332990	2488786	5/28/1998	22:55:15.17	3.870	7.750
136	44.51	16.869	2.167	34.771	12.95	2325469	2487748	5/28/1998	23:01:15.97	3.818	7.746
137	44.492	16.837	2.093	34.782	12.95	2257370	2488290	5/28/1998	23:07:16.77	3.351	7.748
138	44.472	16.82	2.202	34.779	12.95	2319133	2487317	5/28/1998	23:13:17.57	3.775	7.744
139	44.455	16.818	2.154	34.766	12.951	2305456	2488250	5/28/1998	23:19:18.37	3.681	7.748
140	44.432	16.787	2.194	34.773	12.949	2309781	2487183	5/28/1998	23:25:19.17	3.710	7.743
141	44.415	16.776	2.247	34.768	12.949	2319015	2487101	5/28/1998	23:31:19.97	3.774	7.743
142	44.394	16.751	2.193	34.771	12.948	2289664	2487559	5/28/1998	23:38:01.99	3.572	7.745
143	44.37	16.717	2.19	34.78	12.948	2263307	2487832	5/28/1998	23:44:02.79	3.392	7.746
144	44.351	16.709	2.147	34.77	12.946	2311462	2487816	5/28/1998	23:50:03.59	3.722	7.746
145	44.331	16.673	2.127	34.783	12.947	2320541	2487357	5/28/1998	23:56:04.39	3.784	7.744
146	44.306	16.65	2.17	34.781	12.946	2294127	2487148	5/29/1998	00:02:05.19	3.603	7.743
147	44.273	16.621	2.141	34.778	12.947	2332644	2487030	5/29/1998	00:08:05.99	3.867	7.743
148	44.254	16.6	2.127	34.779	12.945	2323867	2487469	5/29/1998	00:14:06.79	3.807	7.745
149	44.211	16.558	2.099	34.778	12.944	2300681	2487058	5/29/1998	00:20:07.59	3.648	7.743
150	44.188	16.526	2.067	34.786	12.943	2278551	2487306	5/29/1998	00:26:08.39	3.496	7.744
151	44.165	16.503	2.034	34.786	12.942	2287298	2487392	5/29/1998	00:32:09.19	3.556	7.744
152	44.135	16.469	2.06	34.789	12.941	2331387	2487051	5/29/1998	00:38:09.99	3.859	7.743
153	44.105	16.452	2.018	34.777	12.942	2295985	2487200	5/29/1998	00:44:10.79	3.616	7.743
154	44.088	16.426	1.986	34.784	12.942	2316765	2487424	5/29/1998	00:50:11.59	3.758	7.744
155	44.081	16.409	1.998	34.793	12.939	2304255	287212	5/29/1998	00:56:12.39	3.673	7.743

Record No.	Conductivity (mS/cm)	Temperature (Deg. C)	Pressure (dBar)	Salinity (PSU)	CTD Bat. (Vdc)	D.O. (Integer)	pH (Integer)	Date	Time	D.O. (ml/L)	pH (Value)
156	44.068	16.398	1.903	34.791	12.94	2228353	2487888	5/29/1998	01:02:13.19	3.152	7.746
157	44.057	16.389	1.925	34.789	12.94	2314425	2487251	5/29/1998	01:08:13.99	3.742	7.744
158	44.051	16.381	1.876	34.791	12.939	2319702	2488199	5/29/1998	01:14:14.79	3.779	7.748
159	44.046	16.384	1.839	34.784	12.939	2336415	2487387	5/29/1998	01:20:15.59	3.893	7.744
160	44.045	16.383	1.79	34.785	12.938	2317515	2488181	5/29/1998	01:26:16.39	3.764	7.748
161	44.045	16.382	1.783	34.785	12.938	2298769	2487598	5/29/1998	01:32:17.19	3.635	7.745
162	44.051	16.378	1.777	34.793	12.94	2317622	2487845	5/29/1998	01:38:17.99	3.764	7.746
163	44.061	16.385	1.689	34.797	12.938	2309962	2488155	5/29/1998	01:44:18.79	3.712	7.748
164	44.069	16.401	1.641	34.79	12.938	2313037	2488007	5/29/1998	01:50:19.59	3.733	7.747
165	44.086	16.425	1.592	34.784	12.938	2291199	2487798	5/29/1998	01:56:20.39	3.583	7.746
166	44.099	16.429	1.587	34.792	12.937	2301553	2489464	5/29/1998	02:02:21.19	3.654	7.753
167	44.117	16.453	1.537	34.787	12.938	2285801	2488157	5/29/1998	02:08:21.99	3.546	7.748
168	44.137	16.47	1.532	34.79	12.938	2299845	2488837	5/29/1998	02:14:22.79	3.642	7.750
169	44.161	16.497	1.441	34.787	12.938	2330472	2488705	5/29/1998	02:20:23.59	3.852	7.750
170	44.189	16.521	1.404	34.79	12.938	2291325	2489317	5/29/1998	02:26:24.39	3.584	7.753
171	44.205	16.544	1.414	34.786	12.938	2313383	2488472	5/29/1998	02:32:25.19	3.735	7.749
172	44.224	16.561	1.335	34.787	12.938	2284055	2488580	5/29/1998	02:38:25.99	3.534	7.749
173	44.246	16.582	1.343	34.788	12.936	2302788	2489789	5/29/1998	02:44:26.79	3.662	7.755
174	44.261	16.599	1.257	34.787	12.937	2234953	2489218	5/29/1998	02:50:27.59	3.197	7.752
175	44.269	16.613	1.192	34.782	12.935	2320161	2489082	5/29/1998	02:56:28.39	3.782	7.752
176	44.285	16.618	1.218	34.791	12.937	2297834	2489306	5/29/1998	03:02:29.19	3.628	7.752
177	44.293	16.635	1.162	34.783	12.937	2314185	2489379	5/29/1998	03:08:29.99	3.741	7.753
178	44.305	16.64	1.103	34.789	12.935	2282847	2488953	5/29/1998	03:14:30.79	3.526	7.751
179	44.317	16.659	1.051	34.784	12.935	2313239	2489215	5/29/1998	03:20:31.59	3.734	7.752
180	44.334	16.658	1.045	34.8	12.934	2327753	2489356	5/29/1998	03:26:32.39	3.834	7.753
181	44.342	16.681	0.969	34.787	12.934	2323343	2488751	5/29/1998	03:32:33.19	3.804	7.750
182	44.372	16.713	0.928	34.785	12.937	2273363	2488426	5/29/1998	03:38:33.99	3.461	7.749
183	44.413	16.751	0.857	34.788	12.935	2298671	2489384	5/29/1998	03:44:34.79	3.634	7.753
184	44.451	16.797	0.837	34.782	12.936	2283134	2488974	5/29/1998	03:50:35.59	3.528	7.751
185	44.487	16.83	0.795	34.784	12.935	2299437	2488495	5/29/1998	03:56:36.39	3.639	7.749
186	44.516	16.855	0.766	34.788	12.935	2318111	2488873	5/29/1998	04:02:37.19	3.768	7.751
187	44.561	16.898	0.719	34.79	12.936	2285798	2489263	5/29/1998	04:08:37.99	3.546	7.752
188	44.604	16.947	0.684	34.785	12.935	2304356	2488959	5/29/1998	04:14:38.79	3.673	7.751
189	44.624	16.97	0.622	34.782	12.937	2333743	2488811	5/29/1998	04:20:39.59	3.875	7.750
190	44.646	16.999	0.599	34.778	12.935	2327689	2488726	5/29/1998	04:26:40.39	3.833	7.750
191	44.689	17.023	0.563	34.794	12.935	2326769	2489019	5/29/1998	04:32:41.19	3.827	7.751
192	44.735	17.089	0.538	34.777	12.936	2280251	2489107	5/29/1998	04:38:41.99	3.508	7.752
193	44.778	17.119	0.527	34.789	12.935	2288164	2488836	5/29/1998	04:44:42.79	3.562	7.750
194	44.815	17.162	0.453	34.784	12.936	2354815	2489096	5/29/1998	04:50:43.59	4.020	7.752
195	44.858	17.201	0.432	34.787	12.936	2327043	2489481	5/29/1998	04:56:44.39	3.829	7.753
196	44.901	17.252	0.405	34.78	12.937	2193583	2488516	5/29/1998	05:02:45.19	2.913	7.749
197	44.955	17.308	0.372	34.779	12.936	2283462	2489276	5/29/1998	05:08:45.99	3.530	7.752
198	44.983	17.337	0.347	34.779	12.936	2331071	2488929	5/29/1998	05:14:46.79	3.857	7.751
199	44.983	17.351	0.316	34.767	12.934	2326903	2488973	5/29/1998	05:20:47.59	3.828	7.751
200	45.026	17.391	0.317	34.769	12.935	2299905	2488970	5/29/1998	05:26:48.39	3.643	7.751
201	45.074	17.43	0.274	34.777	12.935	2297999	2489074	5/29/1998	05:32:49.19	3.630	7.751
202	45.111	17.468	0.274	34.777	12.936	2331391	2488920	5/29/1998	05:38:49.99	3.859	7.751
203	45.156	17.504	0.201	34.785	12.937	2296867	2489300	5/29/1998	05:44:50.79	3.622	7.752
204	45.195	17.561	0.209	34.769	12.939	2321373	2488326	5/29/1998	05:50:51.59	3.790	7.748
205	45.243	17.598	0.216	34.779	12.937	2322803	2488669	5/29/1998	05:56:52.39	3.800	7.750
206	45.28	17.64	0.201	34.775	12.938	2344243	2489041	5/29/1998	06:02:53.19	3.947	7.751
207	45.321	17.679	0.156	34.776	12.936	2378781	2487804	5/29/1998	06:08:53.99	4.184	7.746
208	45.348	17.705	0.179	34.778	12.938	2366713	2488640	5/29/1998	06:14:54.79	4.101	7.750
209	45.388	17.747	0.172	34.776	12.936	2334393	2488707	5/29/1998	06:20:55.59	3.879	7.750
210	45.422	17.791	0.159	34.767	12.937	2255886	2487790	5/29/1998	06:26:56.39	3.341	7.746
211	45.462	17.83	0.169	34.769	12.94	2349147	2487964	5/29/1998	06:32:57.19	3.981	7.747
212	45.51	17.866	0.145	34.779	12.937	2347306	2488192	5/29/1998	06:39:39.22	3.968	7.748
213	45.538	17.905	0.138	34.77	12.936	2291856	2487561	5/29/1998	06:45:40.02	3.587	7.745
214	45.576	17.945	0.143	34.768	12.936	2222965	2487628	5/29/1998	06:51:40.82	3.115	7.745
215	45.616	17.983	0.17	34.77	12.94	2330958	2487773	5/29/1998	06:57:41.62	3.856	7.746
216	45.654	18.03	0.152	34.763	12.937	2322395	2487670	5/29/1998	07:03:42.42	3.797	7.745
217	45.686	18.057	0.166	34.766	12.939	2297551	2487695	5/29/1998	07:09:43.22	3.627	7.746
218	45.721	18.102	0.156	34.758	12.936	2334395	2487626	5/29/1998	07:15:44.02	3.879	7.745
219	45.766	18.14	0.185	34.765	12.939	2357319	2487050	5/29/1998	07:21:44.82	4.037	7.743
220	45.802	18.177	0.195	34.764	12.939	2310795	2487153	5/29/1998	07:27:45.62	3.717	7.743
221	45.838	18.217	0.221	34.76	12.938	2304781	2486748	5/29/1998	07:33:46.42	3.676	7.741
222	45.881	18.255	0.237	34.765	12.937	2374486	2486894	5/29/1998	07:39:47.22	4.155	7.742
223	45.91	18.293	0.255	34.757	12.94	2358374	2486404	5/29/1998	07:45:48.02	4.044	7.740
224	45.943	18.326	0.254	34.758	12.939	2355086	2486334	5/29/1998	07:51:48.82	4.021	7.740
225	45.976	18.356	0.27	34.759	12.94	2289219	2486584	5/29/1998	07:57:49.62	3.569	7.741
226	46.006	18.39	0.296	34.756	12.937	2331209	2486612	5/29/1998	08:03:50.42	3.858	7.741
227	46.037	18.426	0.316	34.751	12.939	2348303	2486396	5/29/1998	08:09:51.22	3.975	7.740
228	46.055	18.446	0.312	34.75	12.937	2260793	2486816	5/29/1998	08:15:52.02	3.374	7.742
229	46.087	18.47	0.341	34.757	12.938	2361113	2486006	5/29/1998	08:21:52.82	4.063	7.738
230	46.116	18.501	0.397	34.755	12.937	2242313	2486667	5/29/1998	08:27:53.62	3.247	7.741
231	46.141	18.525	0.396	34.756	12.935	2325640	2486151	5/29/1998	08:33:54.42	3.819	7.739
232	46.16	18.543	0.402	34.756	12.937	2334223	2486496	5/29/1998	08:39:55.22	3.878	7.740
233	46.174	18.564	0.483	34.751	12.936	2352298	2486551	5/29/1998	08:45:56.02	4.002	7.741
234	46.194	18.577	0.461	34.757	12.936	2334808	2486328	5/29/1998	08:51:56.82	3.882	7.740
235	46.198	18.582	0.484	34.756	12.936	2320176	2485657	5/29/1998	08:57:57.62	3.782	7.737
236	46.196	18.577	0.515	34.758	12.935	2273956	2485540	5/29/1998	09:03:58.42	3.465	7.736
237	46.188	18.582	0.542	34.747	12.934	2371515	2485166	5/29/1998	09:09:59.22	4.134	7.735
238	46.179	18.563	0.528	34.755	12.934	2359711	2485938	5/29/1998	09:16:00.02	4.053	7.738
239	46.16	18.544	0.592	34.756	12.933	2390262	2485802	5/29/1998	09:22:00.82	4.263	7.737
240	46.146	18.524	0.607	34.761	12.936	2376076	2484909	5/29/1998	09:28:01.62	4.165	7.734
241	46.122	18.508	0.608	34.754	12.932	2346540	2485726	5/29/1998	09:34:02.42	3.963	7.737
242	46.11	18.494	0.679	34.756	12.931	2271082	2485496	5/29/1998	09:40:03.22	3.445	7.736
243	46.098	18.49	0.659	34.748	12.931	2342790	2484503	5/29/1998	09:46:04.02	3.937	7.732
244	46.083	18.473	0.689	34.751	12.932	2360399	2484808	5/29/1998	09:52:04.82	4.058	7.733
245	46.071	18.451	0.764	34.759	12.93	2359366	2485051	5/29/1998	09:58:05.62	4.051	7.734
246	46.057	18.44	0.802	34.757	12.93	2339065	2485960	5/29/1998	10:04:06.42	3.911	7.738
247	46.039	18.429	0.778	34.751	12.929	2374929	2485450	5/29/1998	10:10:07.22	4.158	7.736
248	46.033	18.419	0.823	34.755	12.931	2380206	2485436	5/29/1998	10:16:08.02	4.194	7.736
249	46.026	18.406	0.877	34.759	12.931	2347044	2484886	5/29/1998	10:22:08.82	3.966	7.733

Record No.	Conductivity (mS/cm)	Temperature (Deg. C)	Pressure (dBar)	Salinity (PSU)	CTD Bat. (Vdc)	D.O. (Integer)	pH (Integer)	Date	Time	D.O. (ml/L)	pH (Value)
250	46.012	18.396	0.896	34.756	12.928	2355055	2485252	5/29/1998	10:28:09.62	4.021	7.735
251	45.995	18.378	0.951	34.756	12.928	2327764	2485243	5/29/1998	10:34:10.42	3.834	7.735
252	45.973	18.355	0.923	34.757	12.927	2380058	2484446	5/29/1998	10:40:11.22	4.193	7.732
253	45.948	18.336	0.969	34.752	12.906	2359418	2483853	5/29/1998	10:46:12.02	4.051	7.729
254	45.93	18.307	0.962	34.762	12.919	2348663	2485031	5/29/1998	10:52:12.82	3.977	7.734
255	45.892	18.271	1.029	34.759	12.918	2350833	2484387	5/29/1998	10:58:13.62	3.992	7.731
256	45.858	18.234	1.051	34.762	12.919	2329614	2484429	5/29/1998	11:04:14.42	3.847	7.731
257	45.822	18.198	1.064	34.762	12.92	2372916	2484444	5/29/1998	11:10:15.22	4.144	7.731
258	45.801	18.173	1.079	34.765	12.919	2342223	2484663	5/29/1998	11:16:16.02	3.933	7.732
259	45.77	18.143	1.107	34.764	12.918	2350212	2484551	5/29/1998	11:22:16.82	3.988	7.732
260	45.725	18.102	1.137	34.762	12.918	2295768	2484156	5/29/1998	11:28:17.62	3.614	7.730
261	45.672	18.049	1.166	34.761	12.918	2360195	2484763	5/29/1998	11:34:18.42	4.056	7.733
262	45.623	17.988	1.152	34.772	12.918	2325052	2484259	5/29/1998	11:40:19.22	3.815	7.731
263	45.567	17.947	1.168	34.758	12.915	2360377	2484336	5/29/1998	11:46:20.02	4.058	7.731
264	45.498	17.867	1.2	34.768	12.915	2345574	2484232	5/29/1998	11:52:20.82	3.956	7.731
265	45.429	17.793	1.221	34.772	12.913	2335963	2484171	5/29/1998	11:58:21.62	3.890	7.730
266	45.386	17.752	1.233	34.77	12.914	2372696	2484228	5/29/1998	12:04:22.42	4.142	7.731
267	45.334	17.698	1.292	34.772	12.913	2228506	2483885	5/29/1998	12:10:23.22	3.153	7.729
268	45.285	17.653	1.265	34.768	12.912	2321059	2484050	5/29/1998	12:16:24.02	3.788	7.730
269	45.252	17.609	1.294	34.777	12.912	2344872	2484538	5/29/1998	12:22:24.82	3.951	7.732
270	45.214	17.566	1.278	34.781	12.911	2370115	2484017	5/29/1998	12:28:25.62	4.125	7.730
271	45.163	17.518	1.302	34.779	12.911	2323027	2484582	5/29/1998	12:34:26.42	3.801	7.732
272	45.115	17.482	1.279	34.768	12.909	2343015	2484452	5/29/1998	12:40:27.22	3.939	7.732
273	45.081	17.447	1.299	34.768	12.908	2339927	2484048	5/29/1998	12:46:28.02	3.917	7.730
274	45.049	17.416	1.3	34.767	12.909	2336933	2484086	5/29/1998	12:52:28.82	3.897	7.730
275	45.034	17.385	1.287	34.781	12.909	2342602	2484079	5/29/1998	12:58:29.62	3.936	7.730
276	45.007	17.356	1.356	34.782	12.908	2301207	2483829	5/29/1998	13:04:30.42	3.652	7.729
277	44.977	17.326	1.372	34.783	12.908	2319952	2483977	5/29/1998	13:10:31.22	3.780	7.729
278	44.946	17.296	1.333	34.782	12.907	2332314	2484063	5/29/1998	13:16:32.02	3.865	7.730
279	44.918	17.271	1.364	34.779	12.907	2338066	2483642	5/29/1998	13:22:32.82	3.905	7.728
280	44.89	17.239	1.328	34.782	12.905	2340330	2484771	5/29/1998	13:28:33.62	3.920	7.733
281	44.851	17.202	1.309	34.781	12.905	2297767	2484638	5/29/1998	13:34:34.42	3.628	7.732
282	44.811	17.158	1.289	34.784	12.902	2337772	2484419	5/29/1998	13:41:16.46	3.903	7.731
283	44.786	17.13	1.28	34.786	12.903	2332777	2483267	5/29/1998	13:47:17.26	3.868	7.726
284	44.761	17.117	1.305	34.775	12.903	2343545	2483895	5/29/1998	13:53:18.06	3.942	7.729
285	44.712	17.05	1.31	34.791	12.902	2339659	2483953	5/29/1998	13:59:18.86	3.916	7.729
286	44.673	17.009	1.298	34.792	12.901	2321547	2484309	5/29/1998	14:05:19.66	3.791	7.731
287	44.639	16.982	1.33	34.786	12.903	2327921	2483368	5/29/1998	14:11:20.46	3.835	7.727
288	44.607	16.95	1.256	34.785	12.9	2312211	2484264	5/29/1998	14:17:21.26	3.727	7.731
289	44.598	16.924	1.228	34.8	12.901	2327343	2484037	5/29/1998	14:23:22.06	3.831	7.730
290	44.564	16.908	1.224	34.784	12.901	2341677	2483301	5/29/1998	14:29:22.86	3.929	7.727
291	44.536	16.867	1.17	34.795	12.899	2315049	2483388	5/29/1998	14:35:23.66	3.747	7.727
292	44.513	16.851	1.198	34.789	12.898	2329209	2483680	5/29/1998	14:41:24.46	3.844	7.728
293	44.478	16.822	1.231	34.783	12.9	2335562	2483394	5/29/1998	14:47:25.26	3.887	7.727
294	44.451	16.792	1.222	34.786	12.897	2338998	2483843	5/29/1998	14:53:26.06	3.911	7.729
295	44.42	16.75	1.193	34.795	12.9	2324411	2483427	5/29/1998	14:59:26.86	3.811	7.727
296	44.399	16.732	1.145	34.793	12.898	2304612	2484513	5/29/1998	15:05:27.66	3.675	7.732
297	44.364	16.703	1.1	34.786	12.883	2292713	2484593	5/29/1998	15:11:28.46	3.593	7.732
298	44.357	16.668	1.042	34.811	12.888	2308925	2484349	5/29/1998	15:17:29.26	3.705	7.731
299	44.349	16.674	1.108	34.799	12.89	2327934	2484425	5/29/1998	15:23:30.06	3.835	7.731
300	44.34	16.665	1.097	34.798	12.891	2282372	2483891	5/29/1998	15:29:30.86	3.522	7.729
301	44.316	16.646	1.05	34.795	12.892	2315451	2483857	5/29/1998	15:35:31.66	3.749	7.729
302	44.3	16.619	1.033	34.804	12.893	2251383	2483779	5/29/1998	15:41:32.46	3.310	7.729
303	44.283	16.606	1.085	34.8	12.891	2307209	2484265	5/29/1998	15:47:33.26	3.693	7.731
304	44.272	16.592	1.042	34.803	12.891	2332659	2483848	5/29/1998	15:53:34.06	3.867	7.729
305	44.257	16.582	0.982	34.798	12.89	2341376	2484169	5/29/1998	15:59:34.86	3.927	7.730
306	44.228	16.553	0.977	34.798	12.89	2313749	2483931	5/29/1998	16:05:35.66	3.738	7.729
307	44.201	16.521	0.959	34.802	12.89	2330583	2484105	5/29/1998	16:11:36.46	3.853	7.730
308	44.187	16.509	0.923	34.8	12.889	2303860	2484190	5/29/1998	16:17:37.26	3.670	7.730
309	44.176	16.493	0.932	34.804	12.89	2343082	2484519	5/29/1998	16:23:38.06	3.939	7.732
310	44.151	16.467	0.888	34.805	12.888	2343922	2484486	5/29/1998	16:29:38.86	3.945	7.732
311	44.128	16.456	0.881	34.794	12.888	2312010	2485232	5/29/1998	16:35:39.66	3.726	7.735
312	44.127	16.449	0.912	34.799	12.887	2322480	2484327	5/29/1998	16:41:40.46	3.798	7.731
313	44.142	16.468	0.873	34.796	12.889	2315096	2485002	5/29/1998	16:47:41.26	3.747	7.734
314	44.173	16.499	0.837	34.796	12.889	2348395	2485131	5/29/1998	16:53:42.06	3.975	7.734
315	44.191	16.515	0.87	34.798	12.891	2335403	2485378	5/29/1998	16:59:42.86	3.886	7.736
316	44.208	16.533	0.83	34.798	12.891	2330302	2486136	5/29/1998	17:05:43.66	3.851	7.739
317	44.25	16.573	0.852	34.799	12.892	2307566	2486248	5/29/1998	17:11:44.46	3.695	7.739
318	44.286	16.61	0.825	34.8	12.891	2330960	2486217	5/29/1998	17:17:45.26	3.856	7.739
319	44.32	16.644	0.8	34.8	12.892	2332307	2486066	5/29/1998	17:23:46.06	3.865	7.738
320	44.359	16.685	0.741	34.798	12.892	2320140	2486059	5/29/1998	17:29:46.86	3.782	7.738
321	44.393	16.731	0.788	34.789	12.892	2257174	2486583	5/29/1998	17:35:47.66	3.349	7.741
322	44.446	16.761	0.774	34.808	12.891	2338630	2485621	5/29/1998	17:41:48.46	3.908	7.737
323	44.483	16.804	0.821	34.803	12.891	2327171	2486514	5/29/1998	17:47:49.26	3.830	7.740
324	44.519	16.85	0.808	34.796	12.893	2338304	2486065	5/29/1998	17:53:50.06	3.906	7.738
325	44.557	16.884	0.787	34.798	12.892	2343962	2486671	5/29/1998	17:59:50.86	3.945	7.741
326	44.604	16.923	0.815	34.807	12.892	2355998	2486419	5/29/1998	18:05:51.66	4.028	7.740
327	44.638	16.979	0.782	34.787	12.895	2341730	2486646	5/29/1998	18:11:52.46	3.930	7.741
328	44.674	17.01	0.787	34.793	12.893	2296214	2487235	5/29/1998	18:17:53.26	3.617	7.744
329	44.711	17.052	0.762	34.788	12.892	2331940	2487590	5/29/1998	18:23:54.06	3.863	7.745
330	44.742	17.087	0.794	34.785	12.892	2348959	2487156	5/29/1998	18:29:54.86	3.979	7.743
331	44.771	17.113	0.81	34.787	12.892	2320873	2487392	5/29/1998	18:35:55.66	3.787	7.744
332	44.783	17.12	0.776	34.792	12.892	2322974	2486786	5/29/1998	18:41:56.46	3.801	7.742
333	44.794	17.136	0.795	34.788	12.892	2336199	2486699	5/29/1998	18:47:57.26	3.892	7.741
334	44.809	17.151	0.777	34.787	12.892	2321517	2487226	5/29/1998	18:53:58.06	3.791	7.744
335	44.835	17.179	0.82	34.786	12.892	2204881	2487495	5/29/1998	18:59:58.86	2.991	7.745
336	44.849	17.205	0.796	34.776	12.892	2327373	2487420	5/29/1998	19:05:59.66	3.831	7.744
337	44.861	17.208	0.765	34.784	12.893	2343211	2487378	5/29/1998	19:12:00.46	3.940	7.744
338	44.869	17.225	0.749	34.776	12.893	2334512	2487949	5/29/1998	19:18:01.26	3.880	7.747
339	44.901	17.238	0.768	34.793	12.89	2301201	2488307	5/29/1998	19:24:02.06	3.652	7.748
340	44.929	17.266	0.828	34.793	12.891	2348669	2487450	5/29/1998	19:30:02.86	3.977	7.744
341	44.925	17.282	0.876	34.776	12.891	2337543	2488202	5/29/1998	19:36:03.66	3.901	7.748
342	44.923	17.27	0.874	34.784	12.889	2326310	2487967	5/29/1998	19:42:04.46	3.824	7.747
343	44.929	17.262	0.9	34.796	12.889	2313199	2487320	5/29/1998	19:48:05.26	3.734	7.744

Record No.	Conductivity (mS/cm)	Temperature (Deg. C)	Pressure (dBar)	Salinity (PSU)	CTD Bat. (Vdc)	D.O. (Integer)	pH (Integer)	Date	Time	D.O. (ml/L)	pH (Value)
344	44.934	17.277	0.838	34.788	12.89	2352186	2487869	5/29/1998	19:54:06.06	4.002	7.746
345	44.939	17.277	0.9	34.792	12.888	2315448	2487883	5/29/1998	20:00:06.86	3.749	7.746
346	44.919	17.267	0.909	34.783	12.889	2353717	2487396	5/29/1998	20:06:07.66	4.012	7.744
347	44.913	17.253	0.88	34.79	12.888	2346549	2488178	5/29/1998	20:12:08.46	3.963	7.748
348	44.919	17.255	0.869	34.793	12.888	2336872	2487929	5/29/1998	20:18:09.26	3.896	7.747
349	44.917	17.254	0.894	34.793	12.889	2325632	2488405	5/29/1998	20:24:10.06	3.819	7.749
350	44.896	17.244	0.95	34.783	12.889	2334058	2488291	5/29/1998	20:30:10.86	3.877	7.748
351	44.879	17.226	0.984	34.784	12.887	2311488	2488567	5/29/1998	20:36:11.66	3.722	7.749
352	44.859	17.194	1.012	34.794	12.886	2341039	2487927	5/29/1998	20:42:53.70	3.925	7.747
353	44.844	17.181	0.997	34.792	12.885	2344434	2487600	5/29/1998	20:48:54.50	3.948	7.745
354	44.831	17.16	1.025	34.799	12.886	2337312	2488011	5/29/1998	20:54:55.30	3.899	7.747
355	44.813	17.153	1.01	34.789	12.886	2338198	2487658	5/29/1998	21:00:56.10	3.906	7.745
356	44.794	17.127	1.052	34.796	12.884	2344105	2488237	5/29/1998	21:06:56.90	3.946	7.748
357	44.783	17.118	1.028	34.794	12.886	2325453	2487986	5/29/1998	21:12:57.70	3.818	7.747
358	44.77	17.102	1.037	34.796	12.884	2331893	2488251	5/29/1998	21:18:58.50	3.862	7.748
359	44.742	17.079	1.109	34.791	12.883	2340829	2488391	5/29/1998	21:24:59.30	3.924	7.749
360	44.712	17.041	1.096	34.798	12.883	2321772	2488392	5/29/1998	21:31:00.10	3.793	7.749
361	44.673	17.014	1.13	34.788	12.882	2309981	2487718	5/29/1998	21:37:00.90	3.712	7.746
362	44.657	16.995	1.073	34.79	12.881	2339121	2487849	5/29/1998	21:43:01.70	3.912	7.746
363	44.637	16.974	1.173	34.791	12.881	2342414	2488280	5/29/1998	21:49:02.50	3.934	7.748
364	44.597	16.914	1.143	34.808	12.882	2315806	2487417	5/29/1998	21:55:03.30	3.752	7.744
365	44.551	16.87	1.17	34.806	12.879	2307752	2487611	5/29/1998	22:01:04.10	3.697	7.745
366	44.518	16.842	1.205	34.801	12.88	2361652	2487055	5/29/1998	22:07:04.90	4.066	7.743
367	44.492	16.802	1.156	34.814	12.878	2303127	2487274	5/29/1998	22:13:05.70	3.665	7.744
368	44.449	16.774	1.224	34.8	12.88	2330282	2486967	5/29/1998	22:19:06.50	3.851	7.742
369	44.407	16.728	1.246	34.802	12.877	2314107	2486463	5/29/1998	22:25:07.30	3.740	7.740
370	44.371	16.693	1.24	34.802	12.878	2323078	2487037	5/29/1998	22:31:08.10	3.802	7.743
371	44.34	16.665	1.237	34.799	12.876	2336920	2487277	5/29/1998	22:37:08.90	3.897	7.744
372	44.317	16.632	1.307	34.807	12.877	2293848	2487169	5/29/1998	22:43:09.70	3.601	7.743
373	44.281	16.605	1.295	34.799	12.875	2322162	2486511	5/29/1998	22:49:10.50	3.795	7.740
374	44.237	16.564	1.335	34.796	12.878	2329379	2486668	5/29/1998	22:55:11.30	3.845	7.741
375	44.221	16.536	1.283	34.806	12.875	2342634	2486745	5/29/1998	23:01:12.10	3.936	7.741
376	44.209	16.522	1.326	34.808	12.876	2322352	2486988	5/29/1998	23:07:12.90	3.797	7.742
377	44.179	16.504	1.307	34.798	12.874	2328236	2486675	5/29/1998	23:13:13.70	3.837	7.741
378	44.162	16.468	1.334	34.813	12.873	2314743	2486843	5/29/1998	23:19:14.50	3.745	7.742
379	44.149	16.471	1.319	34.799	12.874	2332417	2487581	5/29/1998	23:25:15.30	3.866	7.745
380	44.145	16.456	1.334	34.809	12.873	2307129	2486943	5/29/1998	23:31:16.10	3.692	7.742
381	44.131	16.441	1.366	34.81	12.873	2318263	2486990	5/29/1998	23:37:16.90	3.769	7.742
382	44.113	16.423	1.386	34.809	12.873	2307490	2486819	5/29/1998	23:43:17.70	3.695	7.742
383	44.104	16.419	1.387	34.805	12.872	2313981	2486828	5/29/1998	23:49:18.50	3.739	7.742
384	44.094	16.409	1.371	34.805	12.873	2319829	2486829	5/29/1998	23:55:19.30	3.779	7.742
385	44.085	16.394	1.402	34.811	12.873	2305087	2486923	5/30/1998	00:01:20.10	3.678	7.742
386	44.086	16.395	1.377	34.81	12.874	2316024	2486774	5/30/1998	00:07:20.90	3.753	7.742
387	44.08	16.384	1.409	34.815	12.872	2319964	2486620	5/30/1998	00:13:21.70	3.780	7.741
388	44.068	16.385	1.369	34.803	12.87	2334457	2486747	5/30/1998	00:19:22.50	3.880	7.741
389	44.071	16.377	1.432	34.812	12.871	2312238	2487028	5/30/1998	00:25:23.30	3.727	7.743
390	44.064	16.376	1.384	34.807	12.871	2325207	2486925	5/30/1998	00:31:24.10	3.816	7.742
391	44.062	16.366	1.468	34.815	12.87	2326876	2486570	5/30/1998	00:37:24.90	3.828	7.741
392	44.042	16.339	1.408	34.82	12.869	2328580	2486519	5/30/1998	00:43:25.70	3.839	7.740
393	44.029	16.338	1.329	34.81	12.869	2310907	2486439	5/30/1998	00:49:26.50	3.718	7.740
394	44.016	16.322	1.368	34.812	12.868	2293417	2486540	5/30/1998	00:55:27.30	3.598	7.741
395	44.009	16.32	1.374	34.807	12.868	2333263	2486925	5/30/1998	01:01:28.10	3.872	7.742
396	44.002	16.306	1.333	34.814	12.867	2326284	2486499	5/30/1998	01:07:28.90	3.824	7.740
397	43.996	16.298	1.346	34.815	12.867	2293722	2486428	5/30/1998	01:13:29.70	3.600	7.740
398	43.977	16.281	1.36	34.814	12.866	2305563	2486510	5/30/1998	01:19:30.50	3.682	7.740
399	43.965	16.269	1.286	34.813	12.866	2315140	2486732	5/30/1998	01:25:31.30	3.747	7.741
400	43.965	16.264	1.314	34.818	12.865	2287957	2486861	5/30/1998	01:31:32.10	3.561	7.742
401	43.952	16.253	1.196	34.815	12.866	2324126	2486300	5/30/1998	01:37:32.90	3.809	7.740
402	43.94	16.248	1.21	34.81	12.865	2301704	2487269	5/30/1998	01:43:33.70	3.655	7.744
403	43.934	16.233	1.171	34.818	12.865	2332119	2486575	5/30/1998	01:49:34.50	3.864	7.741
404	43.923	16.222	1.166	34.817	12.865	2283408	2486310	5/30/1998	01:55:35.30	3.529	7.740
405	43.913	16.215	1.127	34.814	12.865	2307587	2486227	5/30/1998	02:01:36.10	3.695	7.739
406	43.904	16.201	1.14	34.818	12.866	2267912	2486592	5/30/1998	02:07:36.90	3.423	7.741
407	43.888	16.187	1.092	34.816	12.866	2313204	2486313	5/30/1998	02:13:37.70	3.734	7.740
408	43.886	16.185	1.067	34.816	12.863	2326112	2486193	5/30/1998	02:19:38.50	3.823	7.739
409	43.882	16.173	1.018	34.824	12.864	2325764	2486166	5/30/1998	02:25:39.30	3.820	7.739
410	43.875	16.165	1.034	34.825	12.863	2293219	2486536	5/30/1998	02:31:40.10	3.597	7.741
411	43.871	16.171	0.956	34.816	12.862	2296363	2486374	5/30/1998	02:37:40.90	3.618	7.740
412	43.867	16.168	0.914	34.814	12.864	2313071	2486533	5/30/1998	02:43:41.70	3.733	7.741
413	43.874	16.169	0.913	34.819	12.864	2312193	2486292	5/30/1998	02:49:42.50	3.727	7.739
414	43.881	16.176	0.883	34.821	12.864	2301838	2486400	5/30/1998	02:55:43.30	3.656	7.740
415	43.892	16.187	0.889	34.821	12.864	2321676	2486633	5/30/1998	03:01:44.10	3.792	7.741
416	43.9	16.2	0.794	34.816	12.863	2316388	2486546	5/30/1998	03:07:44.90	3.756	7.741
417	43.906	16.204	0.678	34.818	12.864	2293921	2486201	5/30/1998	03:13:45.70	3.602	7.739
418	43.917	16.223	0.677	34.812	12.861	2305287	2487239	5/30/1998	03:19:46.50	3.680	7.744
419	43.932	16.225	0.72	34.822	12.86	2298005	2486506	5/30/1998	03:25:47.30	3.630	7.740
420	43.962	16.262	0.666	34.817	12.862	2326747	2487258	5/30/1998	03:31:48.10	3.827	7.744
421	43.997	16.306	0.616	34.81	12.864	2302305	2486826	5/30/1998	03:37:48.90	3.659	7.742
422	44.009	16.319	0.564	34.809	12.861	2322062	2488345	5/30/1998	03:44:30.95	3.795	7.748
423	44.026	16.337	0.556	34.808	12.861	2306504	2486669	5/30/1998	03:50:31.75	3.688	7.741
424	44.061	16.362	0.572	34.817	12.862	2314844	2487926	5/30/1998	03:56:32.55	3.745	7.747
425	44.095	16.398	0.486	34.815	12.862	2310070	2487092	5/30/1998	04:02:33.35	3.712	7.743
426	44.116	16.423	0.442	34.813	12.861	2296476	2487592	5/30/1998	04:08:34.15	3.619	7.745
427	44.119	16.414	0.365	34.824	12.861	2318347	2487428	5/30/1998	04:14:34.95	3.769	7.744
428	44.145	16.434	0.397	34.829	12.861	2307337	2486583	5/30/1998	04:20:35.75	3.694	7.741
429	44.174	16.475	0.383	34.819	12.862	2294535	2487564	5/30/1998	04:26:36.55	3.606	7.745
430	44.191	16.491	0.36	34.819	12.862	2300837	2487137	5/30/1998	04:32:37.35	3.649	7.743
431	44.203	16.495	0.288	34.827	12.862	2318227	2487116	5/30/1998	04:38:38.15	3.768	7.743
432	44.212	16.517	0.237	34.815	12.862	2289925	2486807	5/30/1998	04:44:38.95	3.574	7.742
433	44.218	16.511	0.252	34.826	12.861	2304591	2487024	5/30/1998	04:50:39.75	3.675	7.743
434	44.245	16.555	0.206	34.811	12.862	2324413	2487383	5/30/1998	04:56:40.55	3.811	7.744
435	44.265	16.557	0.177	34.826	12.861	2317846	2486946	5/30/1998	05:02:41.35	3.766	7.742
436	44.277	16.588	0.15	34.811	12.861	2308299	2487312	5/30/1998	05:08:42.15	3.700	7.744
437	44.279	16.593	0.122	34.808	12.861	2314803	2487202	5/30/1998	05:14:42.95	3.745	7.743

Record No.	Conductivity (mS/cm)	Temperature (Deg. C)	Pressure (dBar)	Salinity (PSU)	CTD Bat. (Vdc)	D.O. (Integer)	pH (Integer)	Date	Time	D.O. (ml/L)	pH (Value)
438	44.305	16.613	0.072	34.813	12.86	2309705	2488027	5/30/1998	05:20:43.75	3.710	7.747
439	44.337	16.648	0.058	34.811	12.863	2312600	2486801	5/30/1998	05:26:44.55	3.730	7.742
440	44.37	16.683	0.013	34.81	12.862	2319516	2487222	5/30/1998	05:32:45.35	3.777	7.743
441	44.39	16.691	0.003	34.82	12.861	2330909	2487368	5/30/1998	05:38:46.15	3.855	7.744
442	44.417	16.727	-0.102	34.813	12.861	2315582	2486676	5/30/1998	05:44:46.95	3.750	7.741
443	44.456	16.764	-0.029	34.814	12.862	2328682	2487264	5/30/1998	05:50:47.75	3.840	7.744
444	44.491	16.812	-0.061	34.804	12.861	2327159	2486847	5/30/1998	05:56:48.55	3.830	7.742
445	44.533	16.851	-0.082	34.808	12.861	2319389	2486671	5/30/1998	06:02:49.35	3.776	7.741
446	44.579	16.904	-0.11	34.802	12.862	2340800	2486539	5/30/1998	06:08:50.15	3.923	7.741
447	44.617	16.936	-0.13	34.807	12.863	2246282	2486725	5/30/1998	06:14:50.95	3.275	7.741
448	44.657	16.974	-0.157	34.809	12.862	2331076	2486679	5/30/1998	06:20:51.75	3.857	7.741
449	44.697	17.016	-0.144	34.807	12.863	2307462	2486032	5/30/1998	06:26:52.55	3.695	7.738
450	44.733	17.06	-0.206	34.801	12.863	2336385	2486240	5/30/1998	06:32:53.35	3.893	7.739
451	44.776	17.098	-0.196	34.805	12.863	2335998	2486472	5/30/1998	06:38:54.15	3.890	7.740
452	44.811	17.13	-0.192	34.808	12.864	2330003	2485547	5/30/1998	06:44:54.95	3.849	7.736
453	44.843	17.169	-0.2	34.802	12.863	2326793	2485960	5/30/1998	06:50:55.75	3.827	7.738
454	44.882	17.208	-0.233	34.802	12.862	2298696	2486696	5/30/1998	06:56:56.55	3.634	7.741
455	44.921	17.25	-0.22	34.801	12.864	2316551	2485880	5/30/1998	07:02:57.35	3.757	7.738
456	44.957	17.295	-0.223	34.793	12.864	2342717	2486263	5/30/1998	07:08:58.15	3.937	7.739
457	44.988	17.324	-0.272	34.795	12.864	2330527	2485781	5/30/1998	07:14:58.95	3.853	7.737
458	45.027	17.362	-0.259	34.796	12.864	2332861	2485152	5/30/1998	07:20:59.75	3.869	7.735
459	45.06	17.388	-0.261	34.802	12.864	2341392	2484661	5/30/1998	07:27:00.55	3.927	7.732
460	45.081	17.419	-0.244	34.793	12.864	2330915	2484858	5/30/1998	07:33:01.35	3.856	7.733
461	45.125	17.449	-0.26	34.805	12.864	2343651	2484480	5/30/1998	07:39:02.15	3.943	7.732
462	45.164	17.494	-0.278	34.801	12.865	2347319	2483959	5/30/1998	07:45:02.95	3.968	7.729
463	45.201	17.531	-0.253	34.8	12.864	2345763	2484574	5/30/1998	07:51:03.75	3.957	7.732
464	45.229	17.567	-0.213	34.794	12.865	2333827	2485000	5/30/1998	07:57:04.55	3.876	7.734
465	45.269	17.613	-0.222	34.789	12.865	2330157	2484141	5/30/1998	08:03:05.35	3.850	7.730
466	45.3	17.641	-0.229	34.791	12.864	2336285	2484280	5/30/1998	08:09:06.15	3.892	7.731
467	45.337	17.67	-0.201	34.799	12.864	2331750	2484503	5/30/1998	08:15:06.95	3.861	7.732
468	45.354	17.691	-0.207	34.795	12.865	2348329	2484304	5/30/1998	08:21:07.75	3.975	7.731
469	45.392	17.736	-0.203	34.788	12.865	2360376	2483506	5/30/1998	08:27:08.55	4.058	7.727
470	45.421	17.764	-0.168	34.79	12.865	2352150	2483437	5/30/1998	08:33:09.35	4.001	7.727
471	45.446	17.794	-0.152	34.786	12.867	2343306	2483485	5/30/1998	08:39:10.15	3.941	7.727
472	45.48	17.821	-0.144	34.792	12.865	2321326	2483656	5/30/1998	08:45:10.95	3.790	7.728
473	45.51	17.856	-0.144	34.787	12.867	2372649	2483256	5/30/1998	08:51:11.75	4.142	7.726
474	45.537	17.877	-0.081	34.793	12.865	2337480	2483380	5/30/1998	08:57:12.55	3.901	7.727
475	45.559	17.903	-0.106	34.79	12.865	2356705	2482860	5/30/1998	09:03:13.35	4.033	7.725
476	45.584	17.93	-0.075	34.788	12.865	2343080	2483003	5/30/1998	09:09:14.15	3.939	7.725
477	45.601	17.954	-0.076	34.782	12.866	2357706	2483258	5/30/1998	09:15:14.95	4.039	7.726
478	45.621	17.97	-0.035	34.785	12.866	2342494	2483321	5/30/1998	09:21:15.75	3.935	7.727
479	45.636	17.978	-0.017	34.792	12.867	2343084	2483467	5/30/1998	09:27:16.55	3.939	7.727
480	45.642	17.989	0.008	34.787	12.866	2345917	2483405	5/30/1998	09:33:17.35	3.958	7.727
481	45.65	17.996	0.004	34.788	12.864	2324748	2483245	5/30/1998	09:39:18.15	3.813	7.726
482	45.652	18.004	0.014	34.783	12.868	2351747	2483031	5/30/1998	09:45:18.95	3.998	7.725
483	45.66	18.009	0.081	34.786	12.863	2345949	2483732	5/30/1998	09:51:19.75	3.959	7.728
484	45.662	18.018	0.08	34.779	12.864	2362031	2483083	5/30/1998	09:57:20.55	4.069	7.726
485	45.666	18.017	0.092	34.784	12.865	2374991	2483133	5/30/1998	10:03:21.35	4.158	7.726
486	45.684	18.029	0.115	34.789	12.864	2366854	2482706	5/30/1998	10:09:22.15	4.102	7.724
487	45.692	18.046	0.149	34.781	12.863	2338731	2482179	5/30/1998	10:15:22.95	3.909	7.722
488	45.703	18.051	0.176	34.786	12.865	2354646	2482331	5/30/1998	10:21:23.75	4.018	7.722
489	45.707	18.058	0.207	34.784	12.864	2353211	2482325	5/30/1998	10:27:24.55	4.009	7.722
490	45.714	18.063	0.236	34.785	12.863	2348101	2482263	5/30/1998	10:33:25.35	3.973	7.722
491	45.705	18.051	0.197	34.788	12.865	2359616	2481648	5/30/1998	10:39:26.15	4.052	7.719
492	45.684	18.035	0.25	34.783	12.865	2251659	2481928	5/30/1998	10:46:08.20	3.312	7.721
493	45.669	18.016	0.327	34.787	12.861	2356701	2482500	5/30/1998	10:52:09.00	4.032	7.723
494	45.643	17.987	0.339	34.79	12.861	2327437	2481881	5/30/1998	10:58:09.80	3.832	7.720
495	45.625	17.973	0.34	34.786	12.86	2344082	2482078	5/30/1998	11:04:10.60	3.946	7.721
496	45.608	17.952	0.372	34.789	12.859	2331848	2482260	5/30/1998	11:10:11.40	3.862	7.722
497	45.587	17.938	0.341	34.784	12.859	2280028	2482564	5/30/1998	11:16:12.20	3.506	7.723
498	45.57	17.914	0.4	34.789	12.859	2332656	2481978	5/30/1998	11:22:13.00	3.867	7.721
499	45.549	17.9	0.418	34.783	12.86	2357642	2481849	5/30/1998	11:28:13.80	4.039	7.720
500	45.538	17.882	0.444	34.789	12.859	2330851	2481623	5/30/1998	11:34:14.60	3.855	7.719
501	45.521	17.871	0.452	34.784	12.859	2344205	2481926	5/30/1998	11:40:15.40	3.947	7.721
502	45.5	17.84	0.488	34.793	12.857	2342044	2481678	5/30/1998	11:46:16.20	3.932	7.720
503	45.469	17.819	0.55	34.783	12.858	2353370	2481840	5/30/1998	11:52:17.00	4.010	7.720
504	45.444	17.789	0.534	34.788	12.857	2334722	2481668	5/30/1998	11:58:17.80	3.882	7.719
505	45.424	17.767	0.555	34.789	12.858	2341054	2481409	5/30/1998	12:04:18.60	3.925	7.718
506	45.4	17.738	0.568	34.795	12.856	2319566	2482194	5/30/1998	12:10:19.40	3.778	7.722
507	45.388	17.736	0.581	34.786	12.856	2368102	2482065	5/30/1998	12:16:20.20	4.111	7.721
508	45.374	17.713	0.63	34.793	12.856	2336151	2481421	5/30/1998	12:22:21.00	3.891	7.718
509	45.356	17.694	0.65	34.794	12.856	2330657	2481885	5/30/1998	12:28:21.80	3.854	7.720
510	45.334	17.675	0.635	34.791	12.855	2338667	2481710	5/30/1998	12:34:22.60	3.909	7.720
511	45.328	17.665	0.679	34.794	12.855	2338739	2481293	5/30/1998	12:40:23.40	3.909	7.718
512	45.322	17.668	0.678	34.787	12.854	2341819	2481339	5/30/1998	12:46:24.20	3.930	7.718
513	45.312	17.654	0.706	34.79	12.855	2305778	2481554	5/30/1998	12:52:25.00	3.683	7.719
514	45.306	17.651	0.719	34.787	12.854	2355741	2480928	5/30/1998	12:58:25.80	4.026	7.716
515	45.296	17.631	0.747	34.796	12.854	2352447	2481637	5/30/1998	13:04:26.60	4.003	7.719
516	45.276	17.613	0.785	34.795	12.853	2345655	2481495	5/30/1998	13:10:27.40	3.957	7.719
517	45.232	17.569	0.769	34.794	12.852	2343949	2481561	5/30/1998	13:16:28.20	3.945	7.719
518	45.194	17.536	0.767	34.789	12.852	2316763	2482495	5/30/1998	13:22:29.00	3.758	7.723
519	45.162	17.493	0.813	34.799	12.85	2339920	2481985	5/30/1998	13:28:29.80	3.917	7.721
520	45.135	17.474	0.769	34.793	12.851	2320630	2481709	5/30/1998	13:34:30.60	3.785	7.720
521	45.108	17.451	0.78	34.788	12.85	2338579	2481695	5/30/1998	13:40:31.40	3.908	7.720
522	45.085	17.417	0.789	34.798	12.851	2340791	2481806	5/30/1998	13:46:32.20	3.923	7.720
523	45.063	17.399	0.774	34.794	12.849	2338455	2481271	5/30/1998	13:52:33.00	3.907	7.718
524	45.043	17.381	0.796	34.793	12.85	2343934	2481408	5/30/1998	13:58:33.80	3.945	7.718
525	45.01	17.347	0.834	34.793	12.848	2324896	2482038	5/30/1998	14:04:34.60	3.814	7.721
526	44.972	17.313	0.861	34.79	12.848	2326023	2481267	5/30/1998	14:10:35.40	3.822	7.718
527	44.953	17.27	0.796	34.81	12.847	2349034	2481626	5/30/1998	14:16:36.20	3.980	7.719
528	44.901	17.236	0.847	34.794	12.847	2327044	2481361	5/30/1998	14:22:37.00	3.829	7.718
529	44.86	17.197	0.812	34.792	12.846	2291170	2481187	5/30/1998	14:28:37.80	3.583	7.717
530	44.829	17.152	0.797	34.804	12.844	2323168	2481856	5/30/1998	14:34:38.60	3.802	7.720
531	44.801	17.13	0.793	34.799	12.846	2316254	2481883	5/30/1998	14:40:39.40	3.755	7.720

Record No.	Conductivity (mS/cm)	Temperature (Deg. C)	Pressure (dBar)	Salinity (PSU)	CTD Bat. (Vdc)	D.O. (Integer)	pH (Integer)	Date	Time	D.O. (ml/L)	pH (Value)
532	44.788	17.111	0.79	34.804	12.846	2316198	2481208	5/30/1998	14:46:40.20	3.755	7.718
533	44.76	17.092	0.789	34.797	12.845	2328209	2480747	5/30/1998	14:52:41.00	3.837	7.716
534	44.723	17.059	0.761	34.792	12.843	2317699	2481637	5/30/1998	14:58:41.80	3.765	7.719
535	44.699	17.011	0.803	34.812	12.848	2338119	2480879	5/30/1998	15:04:42.60	3.905	7.716
536	44.661	16.977	0.737	34.809	12.846	2306482	2480838	5/30/1998	15:10:43.40	3.688	7.716
537	44.62	16.937	0.752	34.809	12.843	2335119	2481446	5/30/1998	15:16:44.20	3.884	7.719
538	44.589	16.908	0.706	34.806	12.841	2337976	2480970	5/30/1998	15:22:45.00	3.904	7.716
539	44.545	16.861	0.702	34.809	12.842	2326859	2480761	5/30/1998	15:28:45.80	3.828	7.716
540	44.522	16.833	0.71	34.813	12.841	2309443	2480819	5/30/1998	15:34:46.60	3.708	7.716
541	44.495	16.81	0.7	34.809	12.84	2308420	2480918	5/30/1998	15:40:47.40	3.701	7.716
542	44.465	16.785	0.68	34.804	12.84	2321747	2480805	5/30/1998	15:46:48.20	3.793	7.716
543	44.438	16.749	0.639	34.812	12.84	2325451	2481435	5/30/1998	15:52:49.00	3.818	7.718
544	44.415	16.717	0.648	34.82	12.843	2339895	2481379	5/30/1998	15:58:49.80	3.917	7.718
545	44.39	16.7	0.702	34.813	12.841	2310956	2481340	5/30/1998	16:04:50.60	3.719	7.718
546	44.365	16.675	0.667	34.813	12.839	2334141	2480805	5/30/1998	16:10:51.40	3.878	7.716
547	44.345	16.646	0.554	34.82	12.838	2345454	2481588	5/30/1998	16:16:52.20	3.955	7.719
548	44.321	16.628	0.616	34.815	12.838	2297626	2481229	5/30/1998	16:22:53.00	3.627	7.718
549	44.319	16.644	0.605	34.799	12.837	2300696	2481329	5/30/1998	16:28:53.80	3.648	7.718
550	44.339	16.647	0.628	34.814	12.844	2322034	2481895	5/30/1998	16:34:54.60	3.795	7.720
551	44.338	16.643	0.605	34.816	12.839	2328282	2481681	5/30/1998	16:40:55.40	3.837	7.720
552	44.328	16.634	0.553	34.815	12.84	2327137	2481625	5/30/1998	16:46:56.20	3.830	7.719
553	44.324	16.637	0.535	34.81	12.836	2297017	2482205	5/30/1998	16:52:57.00	3.623	7.722
554	44.333	16.645	0.54	34.811	12.837	2314413	2483107	5/30/1998	16:58:57.80	3.742	7.726
555	44.352	16.648	0.532	34.824	12.837	2320040	2482904	5/30/1998	17:04:58.60	3.781	7.725
556	44.365	16.663	0.505	34.823	12.837	2336185	2482267	5/30/1998	17:10:59.40	3.892	7.722
557	44.36	16.66	0.507	34.822	12.837	2319845	2483847	5/30/1998	17:17:00.20	3.780	7.729
558	44.371	16.687	0.504	34.807	12.837	2335070	2482923	5/30/1998	17:23:01.00	3.884	7.725
559	44.388	16.693	0.461	34.817	12.837	2309966	2483494	5/30/1998	17:29:01.80	3.712	7.727
560	44.408	16.709	0.504	34.821	12.837	2322082	2483483	5/30/1998	17:35:02.60	3.795	7.727
561	44.419	16.722	0.449	34.819	12.836	2327049	2483191	5/30/1998	17:41:03.40	3.829	7.726
562	44.423	16.737	0.424	34.81	12.836	2307450	2483219	5/30/1998	17:47:45.47	3.694	7.726
563	44.448	16.755	0.472	34.815	12.837	2316704	2483429	5/30/1998	17:53:46.27	3.758	7.727
564	44.467	16.776	0.439	34.814	12.837	2325010	2483311	5/30/1998	17:59:47.07	3.815	7.727
565	44.495	16.803	0.416	34.815	12.838	2313522	2483618	5/30/1998	18:05:47.87	3.736	7.728
566	44.517	16.829	0.412	34.812	12.838	2323538	2483754	5/30/1998	18:11:48.67	3.805	7.729
567	44.541	16.854	0.483	34.811	12.837	2331270	2483912	5/30/1998	18:17:49.47	3.858	7.729
568	44.573	16.885	0.424	34.812	12.838	2352604	2484172	5/30/1998	18:23:50.27	4.004	7.730
569	44.598	16.916	0.437	34.807	12.837	2313026	2483971	5/30/1998	18:29:51.07	3.733	7.729
570	44.634	16.943	0.357	34.815	12.836	2314830	2484002	5/30/1998	18:35:51.87	3.745	7.730
571	44.655	16.969	0.343	34.812	12.836	2316661	2483852	5/30/1998	18:41:52.67	3.758	7.729
572	44.682	16.991	0.411	34.816	12.838	2321050	2484249	5/30/1998	18:47:53.47	3.788	7.731
573	44.71	17.03	0.43	34.806	12.838	2305945	2484439	5/30/1998	18:53:54.27	3.684	7.731
574	44.734	17.052	0.379	34.808	12.838	2332542	2484144	5/30/1998	18:59:55.07	3.867	7.730
575	44.757	17.075	0.343	34.808	12.839	2332975	2484085	5/30/1998	19:05:55.87	3.870	7.730
576	44.769	17.084	0.357	34.811	12.836	2324107	2484439	5/30/1998	19:11:56.67	3.809	7.731
577	44.792	17.11	0.318	34.808	12.839	2331388	2484106	5/30/1998	19:17:57.47	3.859	7.730
578	44.81	17.127	0.313	34.809	12.839	2313910	2484145	5/30/1998	19:23:58.27	3.739	7.730
579	44.833	17.152	0.408	34.807	12.837	2328078	2484842	5/30/1998	19:29:59.07	3.836	7.733
580	44.855	17.171	0.355	34.811	12.838	2344090	2484449	5/30/1998	19:35:59.87	3.946	7.732
581	44.871	17.194	0.359	34.805	12.837	2339624	2484332	5/30/1998	19:42:00.67	3.915	7.731
582	44.888	17.21	0.38	34.805	12.837	2344343	2484705	5/30/1998	19:48:01.47	3.948	7.733
583	44.899	17.216	0.373	34.81	12.837	2310087	2484878	5/30/1998	19:54:02.27	3.713	7.733
584	44.904	17.222	0.337	34.809	12.839	2333516	2484756	5/30/1998	20:00:03.07	3.873	7.733
585	44.92	17.234	0.378	34.813	12.837	2316273	2485380	5/30/1998	20:06:03.87	3.755	7.736
586	44.93	17.252	0.355	34.806	12.837	2332862	2484519	5/30/1998	20:12:04.67	3.869	7.732
587	44.942	17.263	0.391	34.807	12.837	2304159	2484443	5/30/1998	20:18:05.47	3.672	7.731
588	44.949	17.269	0.347	34.808	12.838	2337755	2484307	5/30/1998	20:24:06.27	3.902	7.731
589	44.947	17.273	0.403	34.802	12.835	2324849	2484961	5/30/1998	20:30:07.07	3.814	7.734
590	44.957	17.286	0.375	34.8	12.837	2316579	2484758	5/30/1998	20:36:07.87	3.757	7.733
591	44.973	17.294	0.408	34.807	12.836	2340176	2484531	5/30/1998	20:42:08.67	3.919	7.732
592	44.974	17.294	0.409	34.807	12.836	2305631	2484242	5/30/1998	20:48:09.47	3.682	7.731
593	44.97	17.289	0.443	34.809	12.835	2350368	2484706	5/30/1998	20:54:10.27	3.989	7.733
594	44.978	17.31	0.368	34.797	12.835	2320151	2484715	5/30/1998	21:00:11.07	3.782	7.733
595	44.983	17.316	0.409	34.797	12.835	2374950	2484793	5/30/1998	21:06:11.87	4.158	7.733
596	44.992	17.316	0.498	34.805	12.835	2325091	2484815	5/30/1998	21:12:12.67	3.816	7.733
597	45	17.323	0.478	34.805	12.835	2330322	2484339	5/30/1998	21:18:13.47	3.851	7.731
598	44.999	17.321	0.49	34.806	12.835	2323568	2484905	5/30/1998	21:24:14.27	3.805	7.733
599	44.999	17.325	0.439	34.803	12.835	2312131	2484718	5/30/1998	21:30:15.07	3.727	7.733
600	44.999	17.325	0.504	34.803	12.833	2357488	2484551	5/30/1998	21:36:15.87	4.038	7.732
601	45.007	17.332	0.496	34.804	12.835	2356126	2484183	5/30/1998	21:42:16.67	4.029	7.730
602	45.008	17.336	0.5	34.8	12.834	2294992	2484451	5/30/1998	21:48:17.47	3.609	7.732
603	44.995	17.328	0.51	34.797	12.835	2344532	2484532	5/30/1998	21:54:18.27	3.949	7.732
604	44.995	17.318	0.464	34.805	12.833	2338993	2484706	5/30/1998	22:00:19.07	3.911	7.733
605	44.998	17.322	0.551	34.805	12.833	2336063	2484308	5/30/1998	22:06:19.87	3.891	7.731
606	44.988	17.324	0.485	34.794	12.833	2347245	2484718	5/30/1998	22:12:20.67	3.968	7.733
607	44.961	17.29	0.529	34.8	12.831	2327530	2484054	5/30/1998	22:18:21.47	3.832	7.730
608	44.942	17.261	0.601	34.809	12.831	2341420	2484308	5/30/1998	22:24:22.27	3.928	7.731
609	44.929	17.247	0.587	34.81	12.831	2320117	2484368	5/30/1998	22:30:23.07	3.781	7.731
610	44.897	17.211	0.624	34.813	12.832	2318803	2484852	5/30/1998	22:36:23.87	3.772	7.733
611	44.859	17.182	0.581	34.805	12.829	2300451	2484170	5/30/1998	22:42:24.67	3.646	7.730
612	44.842	17.159	0.673	34.81	12.829	2307613	2484224	5/30/1998	22:48:25.47	3.696	7.731
613	44.827	17.15	0.536	34.804	12.83	2342618	2484643	5/30/1998	22:54:26.27	3.936	7.732
614	44.815	17.131	0.656	34.811	12.83	2318363	2484742	5/30/1998	23:00:27.07	3.769	7.733
615	44.809	17.133	0.658	34.804	12.829	2327533	2484803	5/30/1998	23:06:27.87	3.832	7.733
616	44.78	17.102	0.651	34.805	12.828	2331690	2485428	5/30/1998	23:12:28.67	3.861	7.736
617	44.744	17.07	0.707	34.801	12.829	2302998	2484238	5/30/1998	23:18:29.47	3.664	7.731
618	44.72	17.046	0.725	34.801	12.827	2294114	2484737	5/30/1998	23:24:30.27	3.603	7.733
619	44.705	17.029	0.728	34.802	12.827	2331940	2484474	5/30/1998	23:30:31.07	3.863	7.732
620	44.684	16.994	0.73	34.814	12.827	2323665	2483807	5/30/1998	23:36:31.87	3.806	7.729
621	44.651	16.962	0.766	34.813	12.825	2307039	2483608	5/30/1998	23:42:32.67	3.692	7.728
622	44.628	16.949	0.732	34.804	12.825	2329842	2483527	5/30/1998	23:48:33.47	3.848	7.728
623	44.609	16.912	0.744	34.821	12.826	2310986	2484133	5/30/1998	23:54:34.27	3.719	7.730
624	44.583	16.889	0.662	34.817	12.826	2323973	2484025	5/31/1998	00:00:35.07	3.808	7.730
625	44.541	16.85	0.7	34.815	12.826	2314517	2483540	5/31/1998	00:06:35.87	3.743	7.728

Record No.	Conductivity (mS/cm)	Temperature (Deg. C)	Pressure (dBar)	Salinity (PSU)	CTD Bat. (Vdc)	D.O. (Integer)	pH (Integer)	Date	Time	D.O. (ml/L)	pH (Value)
626	44.514	16.81	0.718	34.826	12.825	2305950	2483341	5/31/1998	00:12:36.67	3.684	7.727
627	44.501	16.807	0.795	34.817	12.823	2318720	2484158	5/31/1998	00:18:37.47	3.772	7.730
628	44.482	16.791	0.716	34.814	12.823	2334235	2483380	5/31/1998	00:24:38.27	3.878	7.727
629	44.458	16.757	0.749	34.822	12.823	2303660	2482951	5/31/1998	00:30:39.07	3.668	7.725
630	44.449	16.762	0.773	34.81	12.823	2335158	2484032	5/31/1998	00:36:39.87	3.885	7.730
631	44.442	16.745	0.767	34.819	12.822	2317035	2483806	5/31/1998	00:42:40.67	3.760	7.729
632	44.411	16.72	0.716	34.814	12.822	2335917	2483119	5/31/1998	00:49:22.74	3.890	7.726
633	44.39	16.683	0.792	34.827	12.821	2300259	2483212	5/31/1998	00:55:23.54	3.645	7.726
634	44.382	16.683	0.748	34.819	12.821	2310443	2482885	5/31/1998	01:01:24.34	3.715	7.725
635	44.371	16.673	0.751	34.819	12.821	2310269	2483656	5/31/1998	01:07:25.14	3.714	7.728
636	44.357	16.656	0.692	34.822	12.82	2299976	2483270	5/31/1998	01:13:25.94	3.643	7.726
637	44.352	16.64	0.855	34.831	12.82	2303543	2483911	5/31/1998	01:19:26.74	3.668	7.729
638	44.35	16.65	0.689	34.821	12.819	2311595	2483846	5/31/1998	01:25:27.54	3.723	7.729
639	44.348	16.654	0.729	34.815	12.821	2286198	2482959	5/31/1998	01:31:28.34	3.549	7.725
640	44.335	16.644	0.741	34.813	12.819	2315982	2483572	5/31/1998	01:37:29.14	3.753	7.728
641	44.331	16.629	0.796	34.822	12.819	2308499	2483692	5/31/1998	01:43:29.94	3.702	7.728
642	44.32	16.607	0.786	34.833	12.819	2311654	2483279	5/31/1998	01:49:30.74	3.723	7.726
643	44.312	16.61	0.803	34.822	12.82	2323950	2484053	5/31/1998	01:55:31.54	3.808	7.730
644	44.299	16.592	0.811	34.826	12.819	2315010	2483069	5/31/1998	02:01:32.34	3.746	7.726
645	44.27	16.564	0.756	34.826	12.818	2325696	2482313	5/31/1998	02:07:33.14	3.820	7.722
646	44.238	16.531	0.67	34.826	12.818	2332486	2483377	5/31/1998	02:13:33.94	3.866	7.727
647	44.216	16.517	0.72	34.819	12.817	2304895	2483002	5/31/1998	02:19:34.74	3.677	7.725
648	44.201	16.497	0.666	34.822	12.819	2316913	2483223	5/31/1998	02:25:35.54	3.759	7.726
649	44.179	16.472	0.599	34.825	12.819	2300896	2483244	5/31/1998	02:31:36.34	3.649	7.726
650	44.164	16.461	0.591	34.822	12.818	2284959	2482831	5/31/1998	02:37:37.14	3.540	7.725
651	44.167	16.46	0.637	34.825	12.816	2300911	2482619	5/31/1998	02:43:37.94	3.650	7.724
652	44.166	16.459	0.65	34.825	12.816	2314387	2482802	5/31/1998	02:49:38.74	3.742	7.724
653	44.164	16.459	0.559	34.824	12.816	2299848	2482785	5/31/1998	02:55:39.54	3.642	7.724
654	44.177	16.45	0.539	34.843	12.817	2295863	2482534	5/31/1998	03:01:40.34	3.615	7.723
655	44.185	16.47	0.5	34.832	12.818	2295104	2484127	5/31/1998	03:07:41.14	3.610	7.730
656	44.19	16.487	0.563	34.822	12.815	2303198	2484003	5/31/1998	03:13:41.94	3.665	7.730
657	44.21	16.489	0.547	34.838	12.817	2302181	2484225	5/31/1998	03:19:42.74	3.658	7.731
658	44.218	16.519	0.514	34.818	12.815	2307547	2483527	5/31/1998	03:25:43.54	3.695	7.728
659	44.236	16.534	0.48	34.821	12.816	2302167	2483421	5/31/1998	03:31:44.34	3.658	7.727
660	44.252	16.544	0.422	34.826	12.816	2321940	2483373	5/31/1998	03:37:45.14	3.794	7.727
661	44.281	16.575	0.413	34.826	12.815	2286126	2483456	5/31/1998	03:43:45.94	3.548	7.727
662	44.302	16.603	0.435	34.82	12.818	2297277	2483741	5/31/1998	03:49:46.74	3.625	7.728
663	44.316	16.621	0.369	34.816	12.817	2301073	2483395	5/31/1998	03:55:47.54	3.651	7.727
664	44.336	16.631	0.395	34.825	12.816	2301366	2484162	5/31/1998	04:01:48.34	3.653	7.730
665	44.354	16.658	0.328	34.817	12.818	2308298	2483980	5/31/1998	04:07:49.14	3.700	7.729
666	44.386	16.676	0.344	34.83	12.817	2289449	2483188	5/31/1998	04:13:49.94	3.571	7.726
667	44.415	16.711	0.306	34.824	12.815	2293201	2483129	5/31/1998	04:19:50.74	3.597	7.726
668	44.441	16.736	0.275	34.827	12.816	2303105	2483821	5/31/1998	04:25:51.54	3.665	7.729
669	44.467	16.773	0.315	34.816	12.817	2327860	2483593	5/31/1998	04:31:52.34	3.835	7.728
670	44.492	16.797	0.179	34.818	12.817	2326132	2484109	5/31/1998	04:37:53.14	3.823	7.730
671	44.524	16.825	0.217	34.822	12.817	2306981	2483211	5/31/1998	04:43:53.94	3.691	7.726
672	44.56	16.865	0.18	34.819	12.816	2328597	2483898	5/31/1998	04:49:54.74	3.840	7.729
673	44.589	16.892	0.166	34.821	12.816	2336069	2483030	5/31/1998	04:55:55.54	3.891	7.725
674	44.618	16.924	0.098	34.818	12.816	2309710	2483795	5/31/1998	05:01:56.34	3.710	7.729
675	44.65	16.949	0.109	34.824	12.817	2302109	2483255	5/31/1998	05:07:57.14	3.658	7.726
676	44.68	16.986	0.072	34.818	12.817	2287068	2483245	5/31/1998	05:13:57.94	3.555	7.726
677	44.705	17.007	0.096	34.823	12.817	2315699	2483312	5/31/1998	05:19:58.74	3.751	7.727
678	44.73	17.034	0.003	34.82	12.817	2307496	2483303	5/31/1998	05:25:59.54	3.695	7.727
679	44.754	17.057	0.002	34.821	12.82	2322230	2483423	5/31/1998	05:32:00.34	3.796	7.727
680	44.765	17.066	-0.034	34.823	12.817	2343106	2482430	5/31/1998	05:38:01.14	3.939	7.723
681	44.79	17.107	-0.049	34.81	12.817	2322771	2482915	5/31/1998	05:44:01.94	3.800	7.725
682	44.822	17.131	-0.092	34.817	12.818	2297749	2483116	5/31/1998	05:50:02.74	3.628	7.726
683	44.843	17.156	-0.111	34.814	12.816	2326520	2482718	5/31/1998	05:56:03.54	3.825	7.724
684	44.874	17.183	-0.094	34.817	12.817	2324705	2482674	5/31/1998	06:02:04.34	3.813	7.724
685	44.901	17.221	-0.127	34.808	12.818	2329389	2482970	5/31/1998	06:08:05.14	3.845	7.725
686	44.934	17.248	-0.181	34.814	12.819	2350961	2482526	5/31/1998	06:14:05.94	3.993	7.723
687	44.963	17.282	-0.207	34.808	12.817	2322592	2483004	5/31/1998	06:20:06.74	3.798	7.725
688	44.994	17.31	-0.186	34.812	12.817	2327741	2483266	5/31/1998	06:26:07.54	3.834	7.726
689	45.028	17.349	-0.27	34.808	12.818	2311642	2482408	5/31/1998	06:32:08.34	3.723	7.723
690	45.059	17.375	-0.296	34.812	12.818	2328969	2482993	5/31/1998	06:38:09.14	3.842	7.725
691	45.098	17.409	-0.299	34.816	12.819	2312803	2482564	5/31/1998	06:44:09.94	3.731	7.723
692	45.122	17.431	-0.313	34.818	12.82	2323874	2481855	5/31/1998	06:50:10.74	3.807	7.720
693	45.155	17.474	-0.317	34.81	12.818	2315301	2482609	5/31/1998	06:56:11.54	3.748	7.724
694	45.188	17.509	-0.296	34.808	12.818	2300552	2482936	5/31/1998	07:02:12.34	3.647	7.725
695	45.217	17.534	-0.361	34.812	12.819	2316746	2481802	5/31/1998	07:08:13.14	3.758	7.720
696	45.245	17.565	-0.345	34.81	12.819	2339566	2483458	5/31/1998	07:14:13.94	3.915	7.727
697	45.281	17.605	-0.344	34.805	12.819	2328482	2481765	5/31/1998	07:20:14.74	3.839	7.720
698	45.318	17.649	-0.374	34.8	12.821	2341276	2481853	5/31/1998	07:26:15.54	3.927	7.720
699	45.342	17.67	-0.387	34.802	12.822	2331065	2481193	5/31/1998	07:32:16.34	3.857	7.717
700	45.354	17.68	-0.423	34.804	12.82	2343198	2481314	5/31/1998	07:38:17.14	3.940	7.718
701	45.376	17.705	-0.438	34.802	12.82	2342539	2481924	5/31/1998	07:44:17.94	3.935	7.721

BFSD 2 Triplicate Blank Tests - PAHs
Summary

PAH	Blank Flux (ng/m^2/day)			Repeatability (ng/m^2/day)		
	Test 1	Test 2	Test 3	Average Flux	+/- 95% C.L.	Std. Deviation
1. Naphthalene	-243.5	-448.1	-629.3	-440	218.4	193.0
2. Acenaphthene	-32.4	ND	ND	-32.4	n/a	n/a
3. Acenaphthylene	-350.2	141.0	275.9	22.2	372.9	329.5
4. Fluorene	125.5	-69.3	-84.2	-9	132.4	117.0
5. Phenanthrene	89.0	-39.8	-16.3	11	77.6	68.6
6. Anthracene	182.3	53.1	-324.8	-30	298	263
7. Fluoranthene	-421.5	-1539.0	-1308.9	-1089.8	667.8	590.1
8. Pyrene	76.6	-447.1	-431.9	-267.5	337.3	298.0
9. Benzo(a)anthracene	ND	ND	ND	n/a	n/a	n/a
10. Chrysene	23.9	-61.9	ND	-19.0	84.2	60.7
11. Benzo(b)fluoranthene	ND	ND	-134.3	-134.3	n/a	n/a
12. Benzo(k)fluoranthene	ND	ND	-9.8	-9.8	n/a	n/a
13. Benzo(a)pyrene	ND	ND	ND	n/a	n/a	n/a
14.Indeno(1,2,3-c,d)pyrene	ND	ND	ND	n/a	n/a	n/a
15. Dibenz(a,h)anthracene	ND	ND	ND	n/a	n/a	n/a
16. Benzo(g,h,I)perylene	ND	19.6	ND	19.6	n/a	n/a

BFSD 2 Triplicate Blank Tests - PCBs
Summary

PCB	Blank Flux (ng/m^2/day)			Repeatability (ng/m^2/day)		
	Test 1	Test 2	Test 3	Average Flux	+/- 95% C.L.	Std. Deviation
(8) 2,4'-Dichlorobiphenyl	-66.6	ND	47.8	-9.4	112.2	80.9
(18) 2,2',5-Trichlorobiphenyl	205.2	23.3	27.0	85.2	117.6	104.0
(28) 2,4,4'-Trichlorobiphenyl	-8.0	ND	ND	-8.0	n/a	n/a
(52) 2,2',5,5'-Tetrachlorobiphenyl	ND	7.9	89.9	49	80.4	58.0
(66) 2,3',4,4'-Tetrachlorobiphenyl	53.6	16.6	ND	35	36.2	26.2
(101) 2,2',4,5,5'-Pentachlorobiphenyl	57.8	57.4	-3.5	37	40	35
(118) 2,3',4,4',5-Pentachlorobiphenyl	ND	2.7	2.3	2.5	0.3	0.2
(153) 2,2',4,4',5,5'-Hexachlorobiphenyl	ND	ND	9.5	9.5	n/a	n/a
(180) 2,2',3,4,4',5,5'-Heptachlorobiphenyl	ND	-9.6	ND	-9.6	n/a	n/a
(206) 2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl	-2.8	247.0	-17.0	75.7	168.0	148.5
(209) 2,2',3,3',4,4',5,5',6,6'-Decachlorobiphenyl	-18.5	ND	ND	-18.5	n/a	n/a

BFSD 2 Triplicate Blank Tests - Pesticides
Summary

Pesticide	Blank Flux (ng/m^2/day)			Repeatability (ng/m^2/day)		
	Test 1	Test 2	Test 3	Average Flux	+/- 95% C.L.	Std. Deviation
alpha-Chlordane	7.0	ND	ND	7.0	n/a	n/a
2,4'-DDD	7.0	ND	ND	7.0	n/a	n/a
Methoxychlor	25.7	ND	ND	25.7	n/a	n/a
Endosulfan I	48.8	ND	ND	48.8	n/a	n/a
hexachlorobutadiene	ND	ND	22.0	22.0	n/a	n/a
Heptachlor	304.5	ND	ND	304.5	n/a	n/a
Heptachlor Epoxide	ND	ND	8.8	8.8	n/a	n/a
alpha-hexachlorocyclohexane	3.3	ND	ND	3.3	n/a	n/a
beta-hexachlorocyclohexane	61.0	ND	ND	61.0	n/a	n/a
lindane	35.2	132.3	33.8	67.1	63.9	56.5
trans-Nonachlor	40.8	ND	ND	40.8	n/a	n/a

BFSD 2
Paleta Creek Demonstration Summary

Metal	Flux ($\mu g/m^2/day$)	+/- 95% C.L. ($\mu g/m^2/day$)	Flux rate Confidence (%)	Triplicate Blank Flux ($\mu g/m^2/day$) Average	Triplicate Blank Flux ($\mu g/m^2/day$) +/- 95% C.L.	Bulk Sediment ($\mu g/g$)	Overlying Water ($\mu g/L$)
Copper (Cu)	-6.57	17.74	80.7%	2.82	8.73	165	1.46
Cadmium (Cd)	7.02	3.87	100.0%	-0.52	0.75	1.16	0.06897
Lead (Pb)	4.32	12.39	65.6%	3.16	1.59	98.9	0.07879
Nickel (Ni)	19.44	8.75	99.8%	10.28	7.34	19.1	0.8378
Manganese (Mn)	103.94	957.14	73.3%	-264.85	7.49	405	24.02
Manganese (Mn)[1]	4194.24	101841.76	99.9%	-264.85	7.49	405	24.02
Zinc (Zn)	574.26	274.14	100%	-3.38	-68.61	356	8.38

Other							
Oxygen (O_2)* (*$ml/m^2/day$)	-1341.12	160.18	na	na	na	na	4.7
Silica (SiO_2)* (*$mg/m^2/day$)	28.75	15.63	100%	-1.97	2.88	na	0.79

1. Mn flux calculated on the basis of first three samples due to non-linearity

BFSD 2
Paleta Creek Pre-Demo Summary

Metal	Flux ($\mu g/m^2/day$)	+/- 95% C.L. ($\mu g/m^2/day$)	Flux rate Confidence (%)	Triplicate Blank Flux ($\mu g/m^2/day$) Average	Triplicate Blank Flux ($\mu g/m^2/day$) +/- 95% C.L.	Bulk Sediment ($\mu g/g$)	Overlying Water ($\mu g/L$)
Copper (Cu)	-1.75	19.71	38.1%	2.82	8.73	165	1.54
Cadmium (Cd)	9.64	4.14	100.0%	-0.52	0.75	1.16	0.148
Lead (Pb)	11.06	7.94	100.0%	3.16	1.59	98.9	0.1561
Nickel (Ni)	25.24	4.62	100.0%	10.28	7.34	19.1	0.9262
Manganese (Mn)	71.33	701.54	80.7%	-264.85	7.49	405	28.12
Manganese (Mn)[1]	5763.99	23621.84	100.0%	-264.85	7.49	405	28.12
Zinc (Zn)	715.02	257.38	100.0%	-3.38	65.22	356	8.90
Other							
Oxygen (O_2)* (*$ml/m^2/day$)	-1050.87	86.25	na	na	na	na	5.2
Silica (SiO_2)* (*$mg/m^2/day$)	30.29	11.33	100%	-1.97	2.88	na	0.81

1. Mn flux calculated on the basis of first three samples due to non-linearity

BFSD 2
Pearl Harbor Bishop Point Site Summary

Metal	Flux (µg/m²/day)	+/- 95% C.L. (µg/m²/day)	Flux rate Confidence (%)	Triplicate Blank Flux (µg/m²/day) Average	Triplicate Blank Flux (µg/m²/day) +/- 95% C.L.	Bulk Sediment (µg/g)	Overlying Water (µg/L)
Copper (Cu)	112.46	17.60	100.0%	2.82	8.73	241	0.36
Cadmium (Cd)	1.85	1.96	99.4%	-0.52	0.75	0.3	0.009
Lead (Pb)	0.71	1.11	78.7%	3.16	1.59	93	0.06519
Nickel (Ni)	21.04	15.41	96.3%	10.28	7.34	42.9	0.3934
Manganese (Mn)	223.33	284.79	100.0%	-264.85	7.49	324	1.78
Manganese (Mn)[1]	2177.45	192.60	100.0%	-264.85	7.49	324	1.78
Zinc (Zn)	191.18	54.07	100.0%	-3.38	65.22	304	1.43
Other							
Oxygen (O_2)* (*ml/m²/day)	-567.12	54.96	na	na	na	na	6.5
Silica (SiO_2)* (*mg/m²/day)	118.61	27.62	100%	-1.97	2.88	na	0.31

1. Mn flux calculated on the basis of first three samples due to non-linearity

BFSD 2
Pearl Harbor Middle Loch Summary

Metal	Flux ($\mu g/m^2/day$)	+/- 95% C.L. ($\mu g/m^2/day$)	Flux rate Confidence (%)	Triplicate Blank Flux ($\mu g/m^2/day$) Average	Triplicate Blank Flux +/- 95% C.L.	Bulk Sediment ($\mu g/g$)	Overlying Water ($\mu g/L$)
Copper (Cu)	14.79	3.46	99.9%	2.82	8.73	195	0.80
Cadmium (Cd)	1.80	0.31	100.0%	-0.52	0.75	0.2	0.02277
Lead (Pb)	-0.12	0.43	95.2%	3.16	1.59	34	0.03879
Nickel (Ni)	27.17	15.91	100.0%	10.28	7.34	214	0.9472
Manganese (Mn)	-468.18	683.35	97.9%	-264.85	7.49	1180	52.19
Manganese (Mn)[1]	2131.59	904.57	100.0%	-264.85	7.49	1180	52.19
Zinc (Zn)	49.74	17.25	93.5%	-3.38	65.22	314	2.28
Other							
Oxygen (O_2)* (*$ml/m^2/day$)	-1085.52	64.84	na	na	na	na	4.17
Silica (SiO_2)* (*$mg/m^2/day$)	65.03	42.43	100%	-1.97	2.88	na	1.19

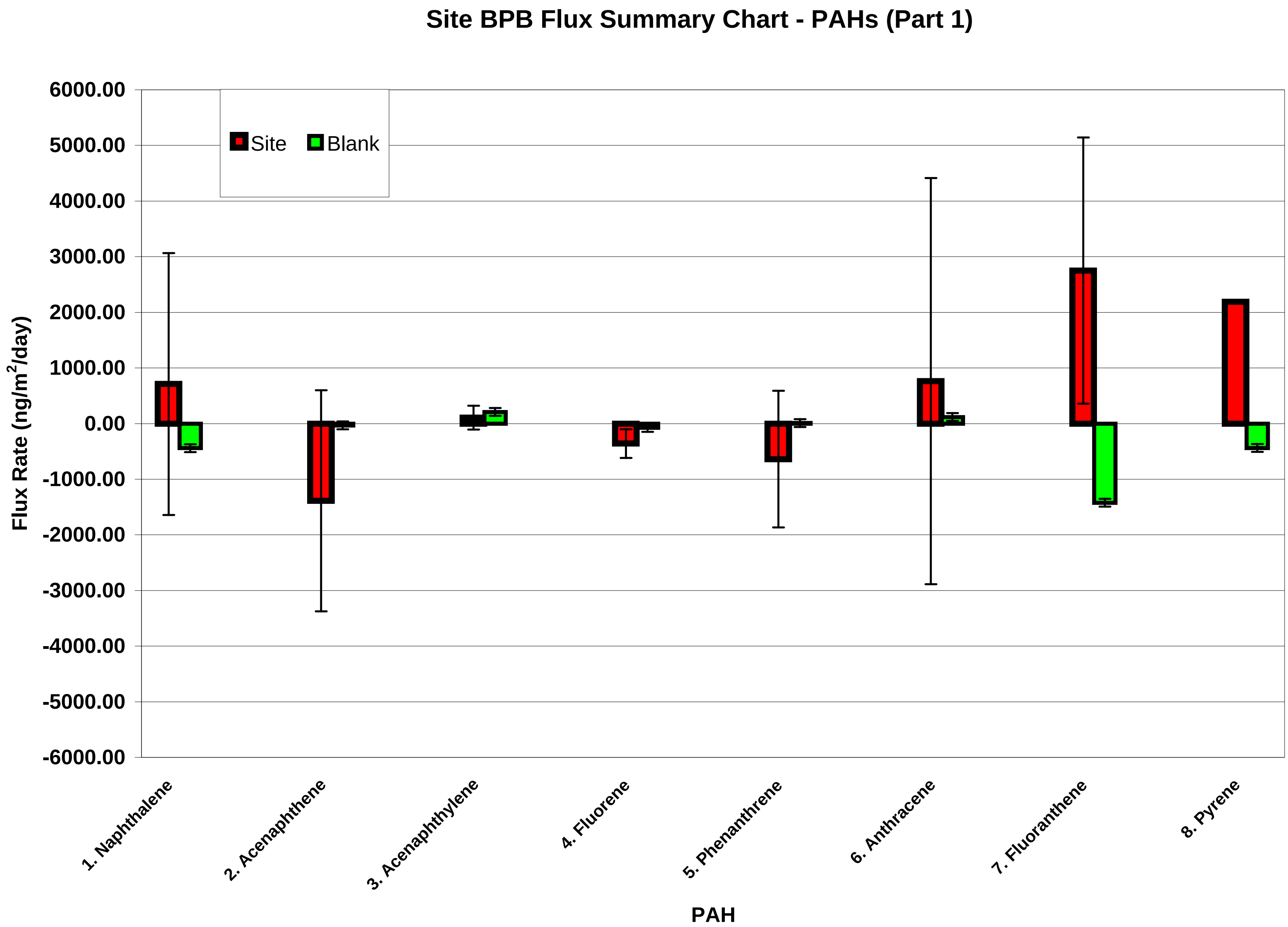
1. Mn flux calculated on the basis of first five samples due to non-linearity

BFSD 2 12/9/2002
BPB Site Summary

Metal	Flux ($\mu g/m^2/day$)*	+/- 95% C.L. ($\mu g/m^2/day$)	Flux rate Confidence (%)	Triplicate Blank Flux ($\mu g/m^2/day$) Average	+/- 95% C.L.	Bulk Sediment ($\mu g/g$)	Overlying Water ($\mu g/L$)
Arsenic (As)	23.48	6.94	100%	-5.16	2.10		
Copper (Cu)	-71.30	39.43	100.0%	2.82	8.73		
Cadmium (Cd)	1.31	1.63	98.1%	-0.52	0.75		
Lead (Pb)	17.40	24.63	99.0%	3.16	1.59		
Nickel (Ni)	59.18	55.96	100.0%	10.28	7.34		
Manganese (Mn)	427.65	238.42	100.0%	-264.85	7.49		
Manganese (Mn)[1]	1940.13	3853.41	100.0%	-264.85	7.49		
Silver (Ag)	-0.36	0.88	86.1%	0.64	0.68		
Zinc (Zn)	374.36	133.74	100.0%	-3.38	65.22		

Other							
Oxygen (O_2)* (*$ml/m^2/day$)	-1457.09	48.92	na	na	na		
Silica (SiO_2)* (*$mg/m^2/day$)	0.00	0.00	48%	-1.97	2.88		

1. Mn flux calculated on the first three samples due to non-linearity and to compare with metals-only demonstration


Site BPB Flux Summary Chart - PAHs (Part 1)
Site
Blank
6000.00
5000.00
4000.00
3000.00
2000.00
1000.00
0.00
-1000.00
-2000.00
-3000.00
-4000.00
-5000.00
-6000.00
Flux Rate (ng/m2/day)
1. Naphthalene
2. Acenaphthene
3. Acenaphthylene
4. Fluorene
5. Phenanthrene
6. Anthracene
7. Fluoranthene
8. Pyrene
PAH

BFSD 2 - 12/9/2003
BPB Site Summary- PAHs (Part 2)

PAH	Flux	+/- 95% C.L.	Flux rate Confidence	Triplicate Blank Flux ($ng/m^2/day$)		Bulk Sediment	Overlying Water
	($ng/m^2/day$)*	($ng/m^2/day$)	(%)	Average	+/- 95% C.L.	(ng/g)	(ng/L)
9. BENZO(A)ANTHRACENE	152.67	140.49	NA	NA	NA		
10. CHRYSENE	286.65	341.92	94.7%	23.94	22.32		
11. BENZO(B)FLUORANTHENE	561.07	376.08	97.9%	-134.30	297.91		
12. BENZO(K)FLUORANTHENE	452.24	465.75	82.8%	-9.71	36.30		
13. BENZO(A)PYRENE	383.46	603.38	NA	NA	NA		
14. INDENO(1,2,3-C,D)PYRENE	8.68	10.98	NA	NA	NA		
15. DIBENZ(A,H)ANTHRACENE	-1.97	7.69	NA	NA	NA		
16. BENZO(G,H,I)PERYLENE	8.77	10.59	12.9%	20.15	65.15		

BFSD 2
BPB Site Summary- PAHs (Part 1)

PAH	Flux	+/- 95% C.L.	Flux Rate Confidence	Triplicate Blank Flux ($ng/m^2/day$)		Bulk Sediment	Overlying Water
	($ng/m^2/day$)*	($ng/m^2/day$)	(%)	Average	+/- 95% C.L.	(ng/g)	(ng/L)
1. Naphthalene	2456.72	13211.62	100.0%	-440.30	458.38		
2. Acenaphthene	9222.27	6867.34	100.0%	-32.40	50.34		
3. Acenaphthylene	778.37	880.29	100.0%	208.47	112.60		
4. Fluorene	285.70	2021.66	100.0%	-76.74	28.38		
5. Phenanthrene	-3555.98	7892.27	100.0%	10.95	10.95		
6. Anthracene	2874.10	1330.22	100.0%	117.68	64.62		
7. Fluoranthene	19696.65	3869.67	100.0%	-1423.95	178.41		
8. Pyrene	12101.21	3884.64	100.0%	-439.51	70.73		

Other
(See Metals Analysis in combined deployments for these data)

Oxygen (O_2)* (*$ml/m^2/day$)	0.00	0.00	na	na	na		
Silica (SiO_2)* (*$mg/m^2/day$)	0.00	0.00	48%	-1.97	2.88		

BFSD 2 - Site BPB (12/9/2002) - PAHs (Part 2)

First 4 samples only

Site: Site BPB (21 19.815 N X 157 58.000W)
Date: 12/9/2003

Start time:
Interval: 7 hr
End time:

Bottle Volume =	0.25 liters
Chamber Volume =	30 liters
Chamber Area =	1701.4 cm^2

Sample id	BFSD 2 Data: Measured Concentration (pptr)**	Sample No.*	Elapsed Time (hrs)	Dilution Correction: Measured Concentration (pptr)**	Corrected Concentration (pptr)**	# of Dilutions	Intercept Corrected Concentration (pptr)	From Regression Concentration (pptr)**	Lower 95% Conf. Int.	Upper 95% Conf. Int.
BENZO(A)ANTHRACENE										
BFSD2-BPB-1	2.72	T-#0	0	2.720		n/a				
BFSD2-BPB-2	4.50	#1	0.3	4.500	4.5000	0	0.237	0.054	-2.783	2.891
BFSD2-BPB-3	5.62	#2	7.3	5.620	5.6348	1	1.371	1.313	-1.524	4.149
BFSD2-BPB-4	6.13	#3	14.3	6.130	6.1690	2	1.906	2.571	-0.266	5.408
BFSD2-BPB-5	8.45	#4	21.3	8.450	8.5174	3	4.254	3.830	0.993	6.667
BFSD2-BPB-6	6.77	#5	28.3	6.770	6.8852	4	2.622	5.089	2.252	7.925
BFSD2-BPB-7	6.99	#6	35.3	6.990	7.1389	5	2.876	6.347	3.510	9.184
BFSD2-BPB-8	7.56	#7	42.3	7.560	7.745	6	3.481	7.606	4.769	10.443
BFSD2-BPB-10	6.51	#9	56.3	6.510	6.9162	8	2.653	10.123	7.286	12.960
BFSD2-BPB-11	8.43	#10	63.3	8.430	8.8904	9	4.627	11.382	8.545	14.219
BFSD2-BPB-12	6.70	#11	70.3	6.700	7.2307	10	2.967	12.640	9.803	15.477
CHRYSENE										
BFSD2-BPB-1	1.18	T-#0	0	1.180		n/a				
BFSD2-BPB-2	7.90	#1	0.3	7.900	7.9000	0	0.797	0.138	-5.671	5.947
BFSD2-BPB-3	10.0	#2	7.3	10.000	10.0560	1	2.953	3.362	-2.447	9.171
BFSD2-BPB-4	12.4	#3	14.3	12.400	12.5295	2	5.427	6.587	0.778	12.396
BFSD2-BPB-5	17.6	#4	21.3	17.600	17.8230	3	10.720	9.811	4.002	15.620
BFSD2-BPB-6	11.5	#5	28.3	11.500	11.8598	4	4.757	13.035	7.226	18.844
BFSD2-BPB-7	12.8	#6	35.3	12.800	13.2458	5	6.143	16.259	10.450	22.068
BFSD2-BPB-8	13.2	#7	42.3	13.200	13.743	6	6.640	19.484	13.675	25.293
BFSD2-BPB-9	11	#8	49.3	10.500	11.1428	7	4.040	22.708	16.899	28.517
BFSD2-BPB-10	16.4	#9	56.3	16.400	17.1205	8	10.018	25.932	20.123	31.741
BFSD2-BPB-11	14.6	#10	63.3	14.600	15.4473	9	8.345	29.156	23.347	34.965
BFSD2-BPB-12	12.6	#11	70.3	12.600	13.5592	10	6.457	32.381	26.572	38.190
BENZO(B)FLUORANTHENE										
BFSD2-BPB-1	2.32	T-#0	0	2.320		n/a				
BFSD2-BPB-2	8.99	#1	0.3	8.990	8.9900	0	0.706	0.133	-12.291	12.558
BFSD2-BPB-3	9.32	#2	7.3	9.320	9.3756	1	1.092	3.241	-9.183	15.665
BFSD2-BPB-4	17.1	#3	14.3	17.100	17.2139	2	8.930	6.349	-6.075	18.773
BFSD2-BPB-5	16.5	#4	21.3	16.500	16.7371	3	8.453	9.457	-2.967	21.881
BFSD2-BPB-6	16.3	#5	28.3	16.300	16.6553	4	8.371	12.565	0.141	24.989
BFSD2-BPB-7	14.8	#6	35.3	14.800	15.2718	5	6.988	15.673	3.249	28.097
BFSD2-BPB-8	18.4	#7	42.3	18.400	18.976	6	10.692	18.781	6.357	31.205
BFSD2-BPB-11	18.7	#10	63.3	18.700	19.5644	9	11.280	28.105	15.680	40.529
BFSD2-BPB-12	18.1	#11	70.3	18.100	19.1203	10	10.836	31.213	18.788	43.637
BENZO(K)FLUORANTHENE										
BFSD2-BPB-1	2.62	T-#0	0	2.620		n/a				
BFSD2-BPB-2	7.42	#1	0.3	7.420	7.4200	0	0.951	0.134	-6.356	6.624
BFSD2-BPB-3	8.15	#2	7.3	8.150	8.1900	1	1.721	3.260	-3.230	9.751
BFSD2-BPB-4	13.4	#3	14.3	13.400	13.4861	2	7.017	6.387	-0.104	12.877
BFSD2-BPB-5	15.9	#4	21.3	15.900	16.0759	3	9.606	9.513	3.023	16.004
BFSD2-BPB-6	10.9	#5	28.3	10.900	11.1866	4	4.717	12.640	6.149	19.130
BFSD2-BPB-7	12.9	#6	35.3	12.900	13.2556	5	6.786	15.766	9.275	22.256
BFSD2-BPB-8	17.9	#7	42.3	17.900	18.341	6	11.872	18.892	12.402	25.383
BFSD2-BPB-11	17.5	#10	63.3	17.500	18.2433	9	11.774	28.271	21.781	34.762
BFSD2-BPB-12	12.4	#11	70.3	12.400	13.2891	10	6.820	31.398	24.907	37.888

BENZO(A)ANTHRACENE – Statistics

Flux Statistics		Blank Statistics	
slope=	0.1798	slope=	#REF!
intercept=	4.2634		
St. Err of Slope=	0.0367		
St Err of Int=	0.4894		
R2=	0.9231		
St Err of Y=	0.5744	St Err of Y=	#REF!
F=	24.01044943		
DF=	2	DF=	#REF!
RegSS=	7.920894225		
ResSS=	0.659787252	ResSS=	#REF!
Sumx2=	16666.5	Sumx2=	#REF!
Average Conc.	6.474		
Initial Conc	4.500		

Comparitive Statistics

$S^2_{(y-x)}$ = #REF!
$S_{(b1-b2)}$ = #REF!
t = #REF!
p = #REF!

Final Results

Flux =	**760.90**	**$ng/m^2/day$**
95% CI (low) =	**92.77**	**$ng/m^2/day$**
95% CI (high) =	**1429.04**	**$ng/m^2/day$**
% Conf (dif from blank)=	**#REF!**	
Blank Flux=	**–134.29613**	**$ng/m^2/day$**
95% CI (low) =	**–432.20593**	**$ng/m^2/day$**
95% CI (high) =	**163.613683**	**$ng/m^2/day$**

LINEST statistics

0.1798	4.2634
0.0367	0.4894
0.9231	0.5744
24.01044943	2
7.920894225	0.659787252

Notes

BFSD2-SPL-10-1
BFSD2-SPL-10-2
BFSD2-SPL-10-3
BFSD2-SPL-10-4
BFSD2-SPL-10-5
BFSD2-SPL-10-6
BFSD2-SPL-10-7
BFSD2-SPL-10-9
BFSD2-SPL-10-10
BFSD2-SPL-10-11

CHRYSENE – Statistics

Flux Statistics		Blank Statistics	
slope=	0.4606	slope=	0.003950364
intercept=	7.1026		
St. Err of Slope=	0.0752		
St Err of Int=	1.0035		
R2=	0.9493		
St Err of Y=	1.1777	St Err of Y=	0.003681693
F=	37.47442787		
DF=	2	DF=	7
RegSS=	51.97894031		
ResSS=	2.774101875	ResSS=	0.511425087
Sumx2=	19096.99	Sumx2=	5390
Average Conc.	12.034		
Initial Conc	7.900		

Comparitive Statistics

$S^2_{(y-x)}$ = 0.365058551
$S_{(b1-b2)}$ = 0.00931906
t = 49.00244917
p = 3.07797E-12

Final Results

Flux =	**1949.20**	**$\mu g/m^2/day$**
95% CI (low) =	**579.19**	**$\mu g/m^2/day$**
95% CI (high) =	**3319.22**	**$\mu g/m^2/day$**
% Conf (dif from blank)=	**100%**	
Blank Flux=	**–9.710954**	**$\mu g/m^2/day$**
95% CI (low) =	**–46.008488**	**$\mu g/m^2/day$**
95% CI (high) =	**26.5865797**	**$\mu g/m^2/day$**

LINEST statistics

0.4606	7.1026
0.0752	1.0035
0.9493	1.1777
37.47442787	2
51.97894031	2.774101875

Notes

BENZO(B)FLUORANTHENE – Statistics

Flux Statistics		Blank Statistics	
slope=	0.4440	slope=	-0.0221561
intercept=	8.2840		
St. Err of Slope=	0.1605		
St Err of Int=	2.1402		
R2=	0.7929		
St Err of Y=	2.5117	St Err of Y=	0.049148994
F=	7.655682812		
DF=	2	DF=	4
RegSS=	48.29702501		
ResSS=	12.61730043	ResSS=	19.88541378
Sumx2=	13496.81	Sumx2=	2058
Average Conc.	13.794		
Initial Conc	8.990		

Comparitive Statistics

$S^2_{(y-x)}$ = 5.417119035
$S_{(b1-b2)}$ = 0.055078017
t = 8.463451966
p = 0.00014867

Final Results

Flux =	**1878.90**	**$\mu g/m^2/day$**
95% CI (low) =	**-1042.88**	**$\mu g/m^2/day$**
95% CI (high) =	**4800.68**	**$\mu g/m^2/day$**
% Conf (dif from blank)=	**100%**	
Blank Flux=	**#РЕФ!**	**$\mu g/m^2/day$**
95% CI (low) =	**#РЕФ!**	**$\mu g/m^2/day$**
95% CI (high) =	**#РЕФ!**	**$\mu g/m^2/day$**

LINEST statistics

0.4440	8.2840
0.1605	2.1402
0.7929	2.5117
7.655682812	2
48.29702501	12.61730043

Notes

BENZO(K)FLUORANTHENE – Statistics

Flux Statistics		Blank Statistics	
slope=	0.4466	slope=	-0.001602108
intercept=	6.4694		
St. Err of Slope=	0.0838		
St Err of Int=	1.1181		
R2=	0.9342		
St Err of Y=	1.3121	St Err of Y=	0.005988347
F=	28.3865123		
DF=	2	DF=	2
RegSS=	48.87136373		
ResSS=	3.443280613	ResSS=	0.117143642
Sumx2=	13496.81	Sumx2=	1633.333333
Average Conc.	11.272		
Initial Conc	7.420		

Comparitive Statistics

$S^2_{(y-x)}$ = 0.890106064
$S_{(b1-b2)}$ = 0.024716639
t = 18.13467808
p = 5.43699E-05

Final Results

Flux =	**1890.04**	**$\mu g/m^2/day$**
95% CI (low) =	**363.70**	**$\mu g/m^2/day$**
95% CI (high) =	**3416.37**	**$\mu g/m^2/day$**
% Conf (dif from blank)=	**100%**	
Blank Flux=	**#РЕФ!**	**$\mu g/m^2/day$**
95% CI (low) =	**#РЕФ!**	**$\mu g/m^2/day$**
95% CI (high) =	**#РЕФ!**	**$\mu g/m^2/day$**

LINEST statistics

0.4466	6.4694
0.0838	1.1181
0.9342	1.3121
28.3865123	2
48.87136373	3.443280613

Notes

BFSD2
BPB Site - 12/9/2002
PAH Flux Analysis

Sample id	BFSD 2 Data: Measured Concentration (pptr)**	Sample No.*	Elapsed Time (hrs)	Dilution Correction: Measured Concentration (pptr)**	Corrected Concentration (pptr)**	# of Dilutions	Intercept Corrected Concentration (pptr)	From Regression Concentration (pptr)**	Lower 95% Conf. Int.	Upper 95% Conf. Int.
BENZO(A)PYRENE										
BFSD2-BPB-1	2.00	T-#0	0	2.000		n/a				
BFSD2-BPB-2	2.00	#1	0.3	2.000	2.0000	0	0.794	0.100	-7.469	7.669
BFSD2-BPB-3	2.00	#2	7.3	2.000	2.0000	1	0.794	2.438	-5.131	10.007
BFSD2-BPB-4	7.19	#3	14.3	7.190	7.1900	2	5.984	4.776	-2.793	12.345
BFSD2-BPB-5	8.02	#4	21.3	8.020	8.0633	3	6.857	7.114	-0.455	14.683
BFSD2-BPB-6	2.00	#5	28.3	2.000	2.0934	4	0.887	9.452	1.883	17.021
BFSD2-BPB-7	6.23	#6	35.3	6.230	6.3234	5	5.117	11.790	4.221	19.359
BFSD2-BPB-8	7.16	#7	42.3	7.160	7.289	6	6.083	14.128	6.559	21.697
BFSD2-BPB-9	18.3	#8	49.3	18.300	18.4717	7	17.266	16.466	8.897	24.035
BFSD2-BPB-10	2.00	#9	56.3	2.000	2.3075	8	1.101	18.804	11.235	26.373
BFSD2-BPB-11	9.68	#10	63.3	9.680	9.9875	9	8.781	21.142	13.573	28.711
BFSD2-BPB-12	6.92	#11	70.3	6.920	7.2915	10	6.085	23.480	15.911	31.049
INDENO(1,2,3-C,D)PYRENE										
BFSD2-BPB-1	1.98	T-#0	0	1.98		n/a				
BFSD2-BPB-2	1.98	#1	0.3	1.98	1.9800	0	0.049	0.003	-0.437	0.443
BFSD2-BPB-3	1.98	#2	7.3	1.98	1.9800	1	0.049	0.072	-0.368	0.512
BFSD2-BPB-4	1.98	#3	14.3	1.98	1.9800	2	0.049	0.141	-0.299	0.581
BFSD2-BPB-5	2.21	#4	21.3	2.21	2.2100	3	0.279	0.210	-0.230	0.650
BFSD2-BPB-6	1.98	#5	28.3	1.98	1.9819	4	0.051	0.279	-0.161	0.719
BFSD2-BPB-7	1.98	#6	35.3	1.98	1.9819	5	0.051	0.348	-0.092	0.788
BFSD2-BPB-8	1.98	#7	42.3	1.980	1.982	6	0.051	0.417	-0.023	0.857
BFSD2-BPB-10	1.98	#9	56.3	1.98	2.1139	8	0.183	0.555	0.115	0.995
BFSD2-BPB-11	1.98	#10	63.3	1.98	2.1304	9	0.199	0.624	0.184	1.064
BFSD2-BPB-12	1.98	#11	70.3	1.98	2.1469	10	0.216	0.693	0.253	1.133
DIBENZ(A,H)ANTHRACENE										
BFSD2-BPB-1	1.67	T-#0	0	1.67		n/a				
BFSD2-BPB-2	1.67	#1	0.3	1.67	1.6700	0	0.040	0.002	-0.361	0.365
BFSD2-BPB-3	1.67	#2	7.3	1.67	1.6700	1	0.040	0.059	-0.304	0.422
BFSD2-BPB-4	1.67	#3	14.3	1.67	1.6700	2	0.040	0.116	-0.247	0.479
BFSD2-BPB-5	1.86	#4	21.3	1.86	1.8600	3	0.230	0.173	-0.190	0.536
BFSD2-BPB-6	1.67	#5	28.3	1.67	1.6716	4	0.042	0.230	-0.133	0.593
BFSD2-BPB-7	1.67	#6	35.3	1.67	1.6716	5	0.042	0.287	-0.076	0.650
BFSD2-BPB-8	1.67	#7	42.3	1.670	1.672	6	0.042	0.344	-0.019	0.707
BFSD2-BPB-9	1.67	#8	49.3	1.67	1.6716	7	0.042	0.401	0.038	0.764
BFSD2-BPB-10	1.67	#9	56.3	1.67	1.6716	8	0.042	0.458	0.095	0.821
BFSD2-BPB-11	1.67	#10	63.3	1.67	1.6716	9	0.042	0.515	0.152	0.878
BFSD2-BPB-12	1.67	#11	70.3	1.67	1.6716	10	0.042	0.572	0.209	0.935
BENZO(G,H,I)PERYLENE										
BFSD2-BPB-1	1.98	T-#0	0	1.9800		n/a				
BFSD2-BPB-2	1.98	#1	0.3	1.9800	1.9800	0	0.047	0.003	-0.418	0.424
BFSD2-BPB-3	1.98	#2	7.3	1.9800	1.9800	1	0.047	0.069	-0.352	0.490
BFSD2-BPB-4	1.98	#3	14.3	1.9800	1.9800	2	0.047	0.135	-0.286	0.556
BFSD2-BPB-5	2.20	#4	21.3	2.2000	2.2000	3	0.267	0.201	-0.220	0.622
BFSD2-BPB-6	1.98	#5	28.3	1.9800	1.9818	4	0.049	0.267	-0.154	0.688
BFSD2-BPB-7	1.98	#6	35.3	1.9800	1.9818	5	0.049	0.333	-0.088	0.754
BFSD2-BPB-8	1.98	#7	42.3	1.980	1.982	6	0.049	0.399	-0.022	0.820
BFSD2-BPB-10	1.98	#9	56.3	1.9800	2.1138	8	0.181	0.531	0.110	0.952
BFSD2-BPB-11	1.98	#10	63.3	1.9800	2.1303	9	0.197	0.597	0.176	1.018
BFSD2-BPB-12	1.98	#11	70.3	1.9800	2.1468	10	0.214	0.663	0.242	1.084

Bottle Volume =	0.25	liters
Chamber Volume =	30	liters
Chamber Area =	1701.4	cm^2

BENZO(A)PYRENE

Flux Statistics		Blank Statistics	
slope=	0.3340	slope=	#REF!
intercept=	1.2062		
St. Err of Slope=	0.0980		
St Err of Int=	1.3076		
R2=	0.8530		
St Err of Y=	1.5345	St Err of Y=	#REF!
F=	11.60645909		
DF=	2	DF=	#REF!
RegSS=	27.3306355		
ResSS=	4.709556169	ResSS=	#REF!
Sumx2=	19096.99	Sumx2=	#REF!
Average Conc.	4.269		
Initial Conc	2.000		

Comparitive Statistics

$S^2_{(y-x)}$ =	#REF!
$S_{(b1-b2)}$ =	#REF!
t =	#REF!
p =	#REF!

Final Results

Flux =	**1413.41**	**μg/m²/day**
95% CI (low) =	**-371.66**	**μg/m²/day**
95% CI (high) =	**3198.48**	**μg/m²/day**
% Conf (dif from blank)=	**#REF!**	
Blank Flux=	**#PEΦ!**	**μg/m²/day**
95% CI (low) =	**#PEΦ!**	**μg/m²/day**
95% CI (high) =	**#PEΦ!**	**μg/m²/day**

LINEST statistics

0.3340	1.2062
0.0980	1.3076
0.8530	1.5345
11.60645909	2
27.3306355	4.709556169

Notes

INDENO(1,2,3-C,D)PYRENE

Flux Statistics		Blank Statistics	
slope=	0.0099	slope=	#REF!
intercept=	1.9310		
St. Err of Slope=	0.0057		
St Err of Int=	0.0759		
R2=	0.6000		
St Err of Y=	0.0891	St Err of Y=	#REF!
F=	3		
DF=	2	DF=	#REF!
RegSS=	0.023805		
ResSS=	0.01587	ResSS=	#REF!
Sumx2=	16666.5	Sumx2=	#REF!
Average Conc.	2.026		
Initial Conc	1.980		

Comparitive Statistics

$S^2_{(y-x)}$ =	#REF!
$S_{(b1-b2)}$ =	#REF!
t =	#REF!
p =	#REF!

Final Results

Flux =	**41.71**	**μg/m²/day**
95% CI (low) =	**-61.91**	**μg/m²/day**
95% CI (high) =	**145.34**	**μg/m²/day**
% Conf (dif from blank)=	**#REF!**	
Blank Flux=	**0**	**μg/m²/day**
95% CI (low) =	**0**	**μg/m²/day**
95% CI (high) =	**0**	**μg/m²/day**

LINEST statistics

0.0099	1.9310
0.0057	0.0759
0.6000	0.0891
3	2
0.023805	0.01587

Notes

DIBENZ(A,H)ANTHRACENE

Flux Statistics		Blank Statistics	
slope=	0.0081	slope=	#REF!
intercept=	1.6296		
St. Err of Slope=	0.0047		
St Err of Int=	0.0627		
R2=	0.6000		
St Err of Y=	0.0736	St Err of Y=	#REF!
F=	3		
DF=	2	DF=	#REF!
RegSS=	0.016245		
ResSS=	0.01083	ResSS=	#REF!
Sumx2=	19096.99	Sumx2=	#REF!
Average Conc.	1.708		
Initial Conc	1.670		

Comparitive Statistics

$S^2_{(y-x)}$ =	#REF!
$S_{(b1-b2)}$ =	#REF!
t =	#REF!
p =	#REF!

Final Results

Flux =	**34.46**	**μg/m²/day**
95% CI (low) =	**-51.14**	**μg/m²/day**
95% CI (high) =	**120.06**	**μg/m²/day**
% Conf (dif from blank)=	**#REF!**	
Blank Flux=	**23.9445835**	**μg/m²/day**
95% CI (low) =	**1.6285102**	**μg/m²/day**
95% CI (high) =	**46.2606567**	**μg/m²/day**

LINEST statistics

0.0081	1.6296
0.0047	0.0627
0.6000	0.0736
3	2
0.016245	0.01083

Notes

BENZO(G,H,I)PERYLENE

Flux Statistics		Blank Statistics	
slope=	0.0094	slope=	0.003324437
intercept=	1.9332		
St. Err of Slope=	0.0054		
St Err of Int=	0.0726		
R2=	0.6000		
St Err of Y=	0.0852	St Err of Y=	0.01074885
F=	3		
DF=	2	DF=	5
RegSS=	0.02178		
ResSS=	0.01452	ResSS=	2.434381089
Sumx2=	16666.5	Sumx2=	4214
Average Conc.	2.024		
Initial Conc	1.980		

Comparitive Statistics

$S^2_{(y-x)}$ =	0.349843013
$S_{(b1-b2)}$ =	0.01019853
t =	0.598530821
p =	0.568339569

Final Results

Flux =	**39.90**	**μg/m²/day**
95% CI (low) =	**-59.22**	**μg/m²/day**
95% CI (high) =	**139.02**	**μg/m²/day**
% Conf (dif from blank)=	**43%**	
Blank Flux=	**#PEΦ!**	**μg/m²/day**
95% CI (low) =	**#PEΦ!**	**μg/m²/day**
95% CI (high) =	**#PEΦ!**	**μg/m²/day**

LINEST statistics

0.0094	1.9332
0.0054	0.0726
0.6000	0.0852
3	2
0.02178	0.01452

Notes

BFSD 2
Bishop Point Summary- PAHs (Part 1)

PAH	Flux ($ng/m^2/day$)*	+/- 95% C.L. ($ng/m^2/day$)	Flux Rate Confidence (%)	Triplicate Blank Flux ($ng/m^2/day$) Average	Triplicate Blank Flux ($ng/m^2/day$) +/- 95% C.L.	Bulk Sediment (ng/g)	Overlying Water (ng/L)
1. Naphthalene	-110.07	596.59	38.1%	-440.30	458.38	44	13
2. Acenaphthene	2680.41	10124.61	51.2%	-32.40	50.34	3,800	37
3. Acenaphthylene	627.85	1483.64	82.7%	208.47	112.60	1,200	5.6
4. Fluorene	75.17	1894.31	23.4%	-76.74	28.38	4,800	19
5. Phenanthrene	-552.72	1305.06	98.2%	10.95	10.95	54,000	32
6. Anthracene	4053.72	3094.52	100.0%	117.68	64.62	10,000	13
7. Fluoranthene	4435.81	10157.65	97.4%	-1423.95	178.41	270,000	52
8. Pyrene	38.99	4132.12	28.5%	-439.51	70.73	150,000	20
Other							
Oxygen (O_2)* (*$ml/m^2/day$)	-2518.63	152.07	na	na	na	na	na
Silica (SiO_2)* (*$mg/m^2/day$)	na	na	na	-1.97	2.88	na	na

BFSD 2
Bishop Point Summary- PAHs (Part 1, First 4 Samples)

PAH	Flux ($ng/m^2/day$)*	+/- 95% C.L. ($ng/m^2/day$)	Flux Rate Confidence (%)	Triplicate Blank Flux ($ng/m^2/day$) Average	+/- 95% C.L.	Bulk Sediment (ng/g)	Overlying Water (ng/L)
1. Naphthalene	1,848	4,406	59.1%	-440.30	458.38	44	13
2. Acenaphthene	71,053	327,575	100.0%	-32.40	50.34	3,800	37
3. Acenaphthylene	6,862	14,388	100.0%	208.47	112.60	1,200	5.6
4. Fluorene	10,387	110,973	100.0%	-76.74	28.38	4,800	19
5. Phenanthrene	3,031	106,690	99.4%	10.95	10.95	54,000	32
6. Anthracene	26,955	27,293	100.0%	117.68	64.62	10,000	13
7. Fluoranthene	69,812	380,981	100.0%	-1423.95	178.41	270,000	52
8. Pyrene	24,512	190,723	100.0%	-439.51	70.73	150,000	20

Other							
Oxygen (O_2)* (*$ml/m^2/day$)	-2518.63	152.07	na	na	na	na	na
Silica (SiO_2)* (*$mg/m^2/day$)	na	na	na	-1.97	2.88	na	na

BFSD 2
Bishop Point Summary- PAHs (Part 1, Last 8 Samples)

PAH	Flux (ng/m²/day)*	+/- 95% C.L. (ng/m²/day)	Flux Rate Confidence (%)	Triplicate Blank Flux (ng/m²/day) Average	Triplicate Blank Flux +/- 95% C.L.	Bulk Sediment (ng/g)	Overlying Water (ng/L)
1. Naphthalene	27.23	1,194.31	58.0%	-440.30	458.38	44.00	13
2. Acenaphthene	-4,815.36	12,199.50	93.5%	-32.40	50.34	3,800.00	37
3. Acenaphthylene	-1,236.56	1,738.17	100.0%	208.47	112.60	1,200.00	5.6
4. Fluorene	-175.37	2,790.40	29.9%	-76.74	28.38	4,800.00	19
5. Phenanthrene	101.84	1,841.97	43.9%	10.95	10.95	54,000.00	32
6. Anthracene	803.06	2,237.54	99.0%	117.68	64.62	10,000.00	13
7. Fluoranthene	-332.26	14,269.51	31.6%	-1423.95	178.41	270,000.00	52
8. Pyrene	-2,125.92	5,818.50	99.0%	-439.51	70.73	150,000.00	20

Other							
Oxygen (O_2)* (*ml/m²/day)	-2518.63	152.07	na	na	na	na	na
Silica (SiO_2)* (*mg/m²/day)	na	na	na	-1.97	2.88	na	na

BFSD 2
Bishop Point Site Summary- PAHs (Part 2)

PAH	Flux	+/- 95% C.L.	Flux rate Confidence	Triplicate Blank Flux ($ng/m^2/day$)		Bulk Sediment	Overlying Water
	($ng/m^2/day$)*	($ng/m^2/day$)	(%)	Average	+/- 95% C.L.	(ng/g)	(ng/L)
9. BENZO(A)ANTHRACENE	75.00	306.84	NA	NA	NA	16,000	Non-Detect
10. CHRYSENE	1048.91	1012.24	98.5%	23.94	22.32	48,000	5.1
11. BENZO(B)FLUORANTHENE	919.89	375.56	99.8%	-134.30	297.91	36,000	6.2
12. BENZO(K)FLUORANTHENE	234.99	156.43	93.3%	-9.71	36.30	10,000	2.5
13. BENZO(A)PYRENE	Non-Detect	NA	NA	NA	NA	12,000	Non-Detect
14. INDENO(1,2,3-C,D)PYRENE	6.72	67.06	NA	NA	NA	7,400	1.6
15. DIBENZ(A,H)ANTHRACENE	Non-Detect	NA	NA	NA	NA	1,500	1.5
16. BENZO(G,H,I)PERYLENE	7.91	64.14	11.6%	20.15	65.15	5,300	1.7

BFSD 2
Bishop Point Site Summary- PAHs (Part 2, First 4 Samples)

PAH	Flux (ng/m^2/day)*	+/- 95% C.L. (ng/m^2/day)	Flux rate Confidence (%)	Triplicate Blank Flux (ng/m^2/day) Average	Triplicate Blank Flux (ng/m^2/day) +/- 95% C.L.	Bulk Sediment (ng/g)	Overlying Water (ng/L)
9. BENZO(A)ANTHRACENE	Non-Detect	NA	NA	NA	NA	16000	Non-Detect
10. CHRYSENE	8792.74	10650.21	100.0%	23.94	22.32	48000	5.1
11. BENZO(B)FLUORANTHENE	3080.74	17862.28	99.4%	-134.30	297.91	36000	6.2
12. BENZO(K)FLUORANTHENE	977.52	3135.54	99.7%	-9.71	36.30	10000	2.5
13. BENZO(A)PYRENE	Non-Detect	NA	NA	NA	NA	12000	Non-Detect
14. INDENO(1,2,3-C,D)PYRENE	122.97	7142.02	NA	NA	NA	7400	1.6
15. DIBENZ(A,H)ANTHRACENE	Non-Detect	NA	NA	NA	NA	1500	1.5
16. BENZO(G,H,I)PERYLENE	33.19	5249.50	7.0%	20.15	65.15	5300	1.7

BFSD 2
Bishop Point Site Summary- PAHs (Part 2, Last 8 Samples)

PAH	Flux	+/- 95% C.L.	Flux rate Confidence	Triplicate Blank Flux ($ng/m^2/day$)		Bulk Sediment	Overlying Water
	($ng/m^2/day$)*	($ng/m^2/day$)	(%)	Average	+/- 95% C.L.	(ng/g)	(ng/L)
9. BENZO(A)ANTHRACENE	Non-Detect	NA	NA	NA	NA	16,000	Non-Detect
10. CHRYSENE	75.45	780.02	29.4%	23.94	22.32	48,000	5.1
11. BENZO(B)FLUORANTHENE	810.32	561.62	99.7%	-134.30	297.91	36,000	6.2
12. BENZO(K)FLUORANTHENE	155.56	270.41	81.2%	-9.71	36.30	10,000	2.5
13. BENZO(A)PYRENE	Non-Detect	NA	NA	NA	NA	12,000	Non-Detect
14. INDENO(1,2,3-C,D)PYRENE	44.68	59.36	NA	NA	NA	7,400	1.6
15. DIBENZ(A,H)ANTHRACENE	Non-Detect	NA	NA	NA	NA	1,500	1.5
16. BENZO(G,H,I)PERYLENE	35.55	101.15	38.6%	20.15	65.15	5,300	1.7

BFSD 2
Bishop Point Demonstration Summary-PCBs

PCB	Flux (ng/m^2/day)*	+/- 95% C.L. (ng/m^2/day)	Flux rate Confidence (%)	Blank Flux (ng/m^2/day)		Bulk Sediment (ng/g)	Overlying Water (ng/L)
				Flux	+/- 95% C.L.		
101 - 2,2',4,5,5'-Pentachlorobiphenyl	-2.62	93.70	4%	57.59	31.49	Non Detect	2.1

BFSD 2
Bishop Point Demonstration Summary-Pesticides

Pesticide	Flux (ng/m^2/day)*	+/- 95% C.L. (ng/m^2/day)	Blank Flux (ng/m^2/day)		Bulk Sediment (ng/g)	Overlying Water (ng/L)
			Flux	+/- 95% C.L.		
Mirex	61.81	110.60	NA	NA	Non Detect	1.00

BFSD 2
Paleta Creek Demonstration Summary- PAHs

PAH	Flux $(ng/m^2/day)$*	+/- 95% C.L. $(ng/m^2/day)$	Flux Rate Confidence (%)	Triplicate Blank Flux $(ng/m^2/day)$ Average	Triplicate Blank Flux +/- 95% C.L.	Bulk Sediment (ng/g)	Overlying Water (ng/L)
1. Naphthalene	459.20	429.58	94.5%	-440.30	458.38	13	6.7
2. Acenaphthene	337.58	178.97	100.0%	-32.40	50.34	19	9.7
3. Acenaphthylene	105.51	183.82	33.8%	208.47	112.60	220	7.6
4. Fluorene	173.17	149.76	100.0%	-76.74	28.38	34	2.3
5. Phenanthrene	489.25	659.77	100.0%	10.95	10.95	240	8.2
6. Anthracene	569.42	260.29	100.0%	117.68	64.62	470	5.3
7. Fluoranthene	365.55	397.63	100.0%	-1423.95	178.41	890	37
8. Pyrene	951.97	755.67	100.0%	-439.51	70.73	740	13

Other							
Oxygen (O_2)* $(*ml/m^2/day)$	-2193.62	146.52	na	na	na	na	na
Silica (SiO_2)* $(*mg/m^2/day)$	na	na	na	-1.97	2.88	na	na

BFSD 2
Paleta Creek Demonstration Summary- PAHs (Part 2)

PAH	Flux	+/- 95% C.L.	Flux rate Confidence	Triplicate Blank Flux (ng/m^2/day)		Bulk Sediment	Overlying Water
	(ng/m^2/day)*	(ng/m^2/day)	(%)	Average	+/- 95% C.L.	(ng/g)	(ng/L)
9. BENZO(A)ANTHRACENE	Non-Detect	NA	NA	NA	NA	500	
10. CHRYSENE	Non-Detect	NA	NA	23.94	22.32	830	
11. BENZO(B)FLUORANTHENE	Non-Detect	NA	NA	-134.30	297.91	1400	
12. BENZO(K)FLUORANTHENE	Non-Detect	NA	NA	-9.71	36.30	470	
13. BENZO(A)PYRENE	Non-Detect	NA	NA	NA	NA	790	
14. INDENO(1,2,3-C,D)PYRENE	-65.35	906.77	NA	NA	NA	470	1.40
15. DIBENZ(A,H)ANTHRACENE	Non-Detect	NA	NA	NA	NA	120	
16. BENZO(G,H,I)PERYLENE	-46.63	263.97	67.7%	20.15	65.15	400	1.40

BFSD 2
Paleta Creek Demonstration Summary-PCBs

PCB	Flux (ng/m²/day)*	+/- 95% C.L. (ng/m²/day)	Flux rate Confidence (%)	Blank Flux (ng/m²/day) Flux	Blank Flux (ng/m²/day) +/- 95% C.L.	Bulk Sediment (ng/g)	Overlying Water (ng/L)
18 - 2,2',5-Trichlorobiphenyl	52.21	103.93	4%	76.82	36.49	2.6	ND
28 - 2,4,4'-Trichlorobiphenyl	41.52	80.03	61%	-8.05	82.03	2.2	1.1
52 - 2,2',5,5'-Tetrachlorobiphenyl	9.44	105.28	77%	72.74	28.12	4.9	3
66 - 2,3',4,4'-Tetrachlorobiphenyl	-19.94	62.01	96%	37.74	25.45	5.3	ND
101 - 2,2',4,5,5'-Pentachlorobiphenyl	45.99	84.58	17%	57.59	31.49	13	ND
118 - 2,3',4,4',5-Pentachlorobiphenyl	-2.34	123.95	9%	2.51	15.40	13	ND
153 - 2,2',4,4',5,5'-Hexachlorobiphenyl	22.26	78.55	43%	9.45	11.71	23	0.11

BFSD 2
Paleta Creek Demonstration Summary-Pesticides

Pesticide	Flux	+/- 95% C.L.	Blank Flux ($ng/m^2/day$)		Bulk Sediment	Overlying Water
	($ng/m^2/day$)*	($ng/m^2/day$)	Flux	+/- 95% C.L.	(ng/g)	(ng/L)
2,4'-DDT	57.49	95.75	NA	NA	3.6	0.88
4,4'-DDT	31.23	55.47	NA	NA	14	ND
Dieldrin	-23.48	45.68	NA	NA	2	ND
Hexachlorobenzene	23.76	35.20	NA	NA	0.61	ND
Mirex	36.23	154.93	NA	NA	ND	ND

Appendix C

Standard Procedures and Checklists

****

<u>BFSD 2</u>
<u>ON DECK FINAL CHECKLIST</u>

1. **Establish Laptop communications and verify “Sensor Check/Br^- Injection” program file is loaded.**

2. **Oxygen Tank - Turn Valve <u>ON</u>**

3. **Br^- Injection Valve <u>OPEN</u> (in-line position)**

4. **Sensor Caps - Slide CTD back and <u>REMOVE</u> O_2 & pH storage solution caps (reinstall CTD)**

5. **Vacuum Check - Assure bottles #2- #12 have <u>>25 in-Hg</u>**

6. **<u>INSTALL</u> Check Valve plugs in bottles #2 - #12 (hand tight + ½ turn)**

7. **Check each insertion lever movement and light function**

8. **Check Camera FOV – Coverage of Insertion lights, lid closure, collection chamber & Br^- Injection vent bubbles**

9. **Open & latch lid - set rotary latch for <u>½ turn</u>**

10. **Evacuate Bottle #1 to >25 in-Hg and install check valve plug**

11. **Rig release hasp and proceed to <u>water entry</u>**

<u>BFSD 2</u>
<u>IN WATER FINAL PROCEDURE/CHECKLIST</u>

1. Lift BFSD, remove wheels and suspend over water

2. Submerge fully, stop and inspect for evidence of leakage

3. Lower to within view of bottom and inspect surface for adequate landing and seal potential

4. Execute bottom landing/chamber insertion by either
- **a. slowly descending and assuring insertion light function with minimum loss of visibility, or**
- **b. rapidly descending and assuring insertion light function with possible impaired visibility.**

<u>IMPORTANT</u> – Surface vessel must be able to hold position (+/- ~50 feet) for next 30 minutes (max). Overboard cables must not be allowed to tighten and disturb BFSD insertion.

5. Run "Sensor Check/Br^- Injection" program and visually verify lid closure followed by vent bubbles (Br^- Injection). Verify commands for CTD, pump and sensor operation by evidence of laptop computer data. After ~10 minutes, upload data, paste into Excel template and establish ambient O_2 level and control values.

6. Modify final test program with selected O_2 control limits and download to CTD - <u>verify</u> all loops

7. Run final test program and if surface vessel position hold allows, verify operation from laptop data.

8. <u>Important</u> – <u>*First*</u> close Laptop communications interface and *then* disconnect cables

9. Install and tape watertight connectors, bundle cables and cast overboard - clear of BFSD location

10. Record location, weather conditions, etc, and secure for departure

BFSD 2
SHORESIDE DEPLOYMENT PREPARATIONS

1. Batteries checked/replaced/refreshed:
   - **a. Gel cell charged to 24 Vdc @ 25 ma rate**
   - **b. 14 new D-Cells - pump**
   - **c. 6 new 9 Vdc batts - acoustic receiver**
   - **d. 1 new D-Cell - landing lights**
   - **e. CTD checked for 10+ Vdc**

2. All components cleaned:
   - **a. Sample bottles cleaned, assembled and vacuum checked (with slow leakers identified for early positions)**
   - **b. Pneumatic syringe cleaned and loaded w/52 ml Br^- concentrate**
   - **c. Valves/tubing fully rinsed and dried**
   - **d. Chamber cleaned (and "bagged" if req'd)**

3. Check loops confirm all subsystems operational

4. Rotary valves in "start" position

5. Bottles installed and >25 in-Hg applied (any slow leakers in early positions).

6. O_2 pressure checked and adequate for deployment

7. Pneumatic syringe installed

8. Acoustic Receiver prepared:
   a. Ground plate sanded/buffed clean of deposits
   b. Switch in "ON" position
   c. Burn wire (with one wire removed) installed
   d. Function test performed

8. Sensors Calibrated

9. Laptop Status
   a. Loops designed & checked
   b. File structure set up (Operations: Loops Library/Data)
   c. Template functions adjusted for calibrations

BFSD 2
DEPLOYMENT EQUIPMENT LIST

1. **Cables**
   - **one 75’ primary underwater 3-cable set (Comm, Video, light)**
   - **three Pigtail cables for Laptop comm, TV/VCR, Light**
   - **Underwater connector plugs**

2. **Computer Case**
   - **Laptop computer**
   - **AC Power supply**
   - **Log book**
   - **Check lists, cheat sheets, etc**
   - **Floppy drive w/data discs**
   - **Mouse w/pad**

3. **TV/VCR, controller, VHS Tape(s)**

4. **Video camera power supply**

5. **Tool box**

6. **Extension cord/power strip**

7. **Hand vacuum pump**

BFSD 2
RETRIEVAL/RECOVERY CHECKLIST

1. **Stand off from deployment location > 100' and transmit coded sonar pulse using EdgeTech deck unit (2 series of pulses). Allow 15 min (max) for buoy to deploy and reach surface.**

2. **Prepare deck hoist equipment and attach to buoy line**

3. **Raise to a visible depth and inspect/clear any fouling.**

4. **Raise above surface, open and secure lid, and washdown over water. Clear cables and haul onboard**

5. **Haul over deck, install pneumatic wheels and lower to deck**

6. **Turn Oxygen tank valve "off"**

7. **Verify system is shut down (ie, pump off). Inspect for damage, leakage and/or other abnormalities**

8. **Inspect and note bottle fill conditions, Br^- syringe injection condition, and measure "scum" line location**

9. **Slide CTD back and install pH and O_2 storage caps**

10. **Disconnect "comm" cable plug and upload data to prepared file location. Record copy of data to floppy disc.**

11. **Remove and label sample bottles one at a time, capping inlet port immediately upon removal of teflon fill tube.**

12. **Disconnect cables and plug open connectors. Secure cables.**

13. **Thoroughly wash down with fresh water and flush valves/tubing with fresh/DI water without delay**

<u>BFSD 2</u>

<u>Sample Bottle Cleaning and Preparation</u>

1. **Disassembly for cleaning (After sample removed)**
   a. **By hand, unscrew and remove lid from bottle. <u>Avoid gripping and turning filter holder</u>. Set bottle aside.**
   b. **By hand, unscrew filter holder halves. <u>Avoid gripping and turning bottle lid</u>. Using tweezers, remove membrane filter and store in marked Petre dish (if required). Remove orange O-ring and, using blunt object, dislodge and remove black filter support. Set lid/lower filter holder, O-ring and support assembly aside.**
   c. **Using crescent wrench, unscrew and remove plug from top of check valve (if still there), then unscrew and remove spring retainer from top of check valve. Remove spring and valve plunger. Set parts aside.**
   d. **Using crescent wrench, unscrew and remove tubing plug from upper filter holder/tee assembly. Set parts aside.**

2. **Cleaning**
   a. **Rinse all parts in tap water to remove loose material.**
   b. **Rinse all parts thoroughly in deionized water.**
   c. **Soak all parts in 4% RBS solution for 4 hours minimum (24 hours preferred)**
   d. **Rinse all parts in deionized water**
   e. **Soak sample bottles and teflon tubing plugs in 25% nitric acid solution for 4 hours minimum (24 hours preferred)**
   f. **Soak Upper and lower filter holder assemblies, orange O-rings and black filter supports in 10% nitric acid for 4 hrs (24 hours is OK but NOT preferred).**
   g. **Rinse all parts in deionized water followed by thorough rinsing with 18meg-ohm water.**

h. Set all parts in vented hood and allow to thoroughly air dry (overnight is preferred).

3. Assembly and preservation

a. Assemble in the reverse the order of 1. above, with the following additions:

- **Apply a very thin layer of silicon grease to the check valve O-ring. Using the attached spring, lower the assembly into the check valve body and fully rotate it several times against the mating seat. Secure the spring with the retainer and tighten with a crescent wrench.**
- **Snap a black filter support into the lower filter holder/lid assembly. Using tweezers, secure a membrane filter and position it on top of the filter support. Position an orange O-ring on top of the membrane filter and hand tighten the upper filter holder assembly in place. Securely tighten the assembly taking care not to grip and/or rotate the lid.**
- **Assemble a tube plug and tighten with a crescent wrench.**
- **Install a teflon gasket into the sample bottle lid (if used) and securely tighten the lid assembly to the sample bottle. Avoid gripping and/or turning the filter holder.**
- **Using a hand vacuum pump, evacuate the finished assemble to 25 in-Hg and set aside for 4 hours minimum (24 hours is preferred).**
- **If no leakage occurs, sample bottles may be used. If slight leakage occurs on a few, they may be labled and used early in sample sequence. Leakage may be resolved by further tightening of sample bottle lid. Any leakage resolution requiring disassembly shall include cleaning as above.**